Editorial

THE need for radio technicians with a well-balanced theoretical and practical knowledge is greater today than ever before. But project engineers still lament the fact that too many of their bright boys have book-knowledge only, while other promising people are so deficient in first principles that they can work only under instruction when approaching unfamiliar ground.

In the early days of radio there might have been some excuse for this lack of balance. There was only one way to learn anything about radio and that was to work at it. Most book knowledge was elementary stuff about batteries, motors and transformers. It had to be dug up, as there were no schools or special courses to be had. The radio man of the day had largely to teach himself.

Today the picture is different. Tomorrow's engineers have unrivalled opportunities, and they need them. There is so much ground to be caught up before a student is qualified that it requires hard work and persistence to make the grade.

It is quite essential, however, that our engineers and technicians should realise this need for a combined theoretical and practical experience. We have all had contact in the past with the mathematical and design genius who becomes so lost in his own approach that he is if anything somewhat contemptuous of the practical man who must make the things he has designed. We've all laughed at the old "Heath Robinson" devices of the impractical genius, but behind the laughter there is very real truth.

This truth is that the balanced training is the most valuable training, no matter whether we are thinking of high-grade design engineering or radio servicing.

We can only do a job properly if we have a clear mental picture of why we are doing it. Conversely our knowledge of what might need to be done isn't much help unless we know the best and most efficient method of doing it.

I would strongly advise any young man working on a radio career to regard his soldering iron as an essential part of his equipment. He may be luckier than the old timer who is stronger in the realm of useful kinks than on maths. But he won't be a better radio man unless he adds that wealth of practical application to the better basic training he has been able to get today.

The engineer who progresses too far from his work bench won't keep his top rating very long.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

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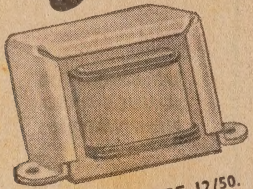
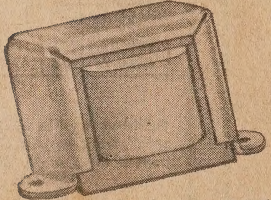
We know you've missed the help of these two sturdy Rola chokes in solving your filtration problems, but here they are again, sturdier and better than ever.

You'll notice that the Type 12/50 choke has been completely re-designed with a new moulded former and terminal lugs which even the most ham-handed solderer will not be able to loosen. Type 14/60, too, has been improved although its changes will not be so readily apparent.

Really top grade electrical steels are almost impossible to get these days, but by specially treating steels which are available Rola is able to maintain the high standards set for its filter chokes – chokes which really do live up to their claimed inductance ratings.



TYPE 12/50.
Inductance 12 Henries at 50 mA. D.C. with 10 volts 100 cycles A.C. superimposed.



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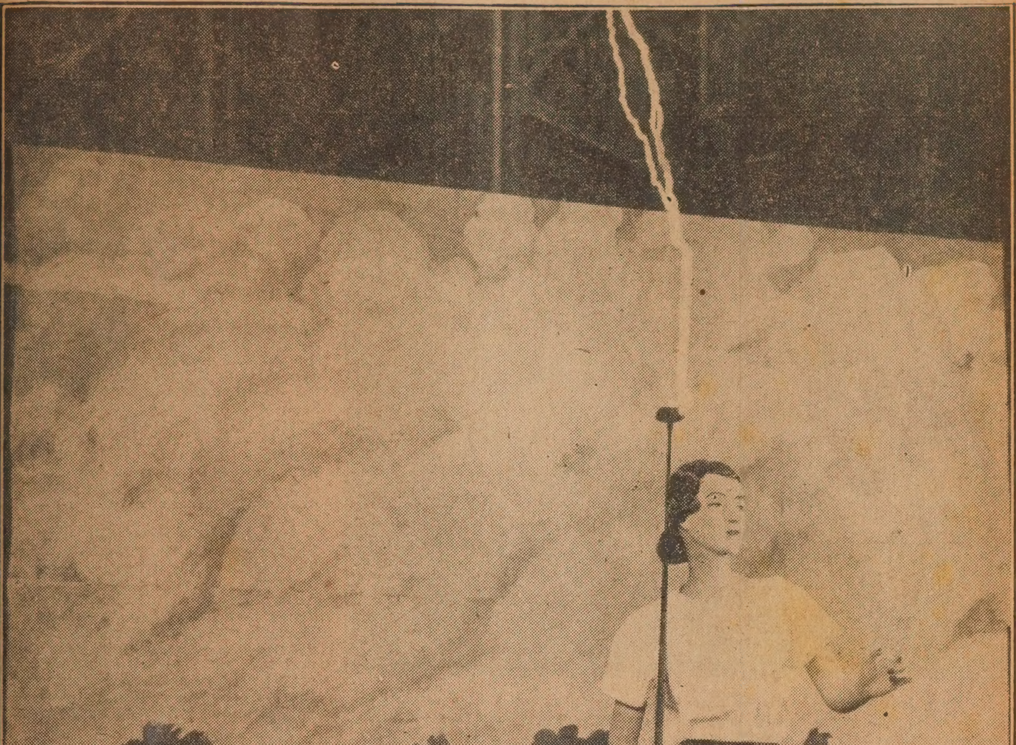
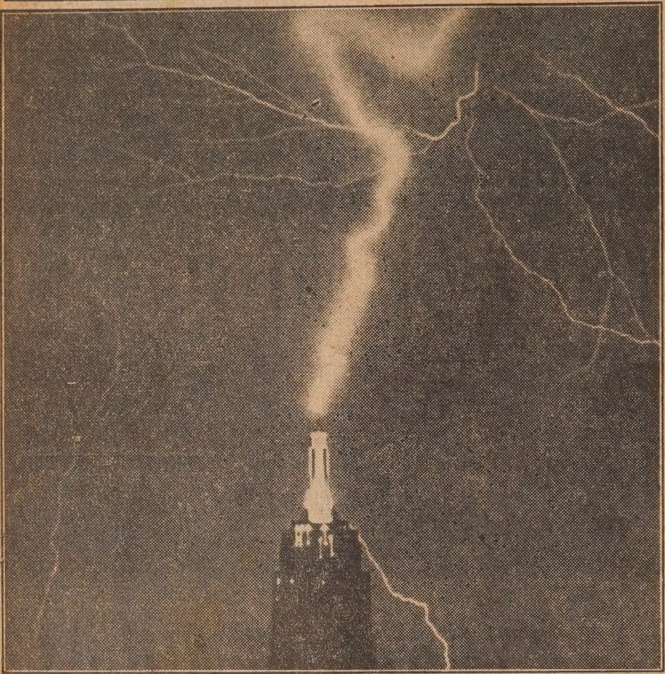
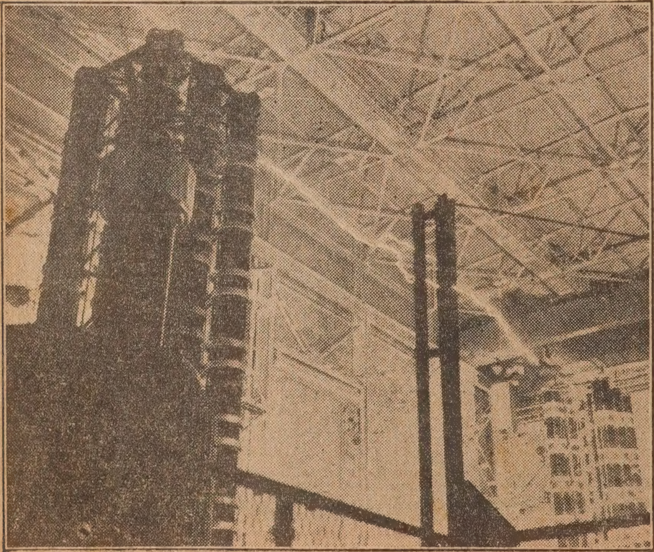


IF you get caught on the golf course in a thunderstorm, don't seek shelter under a tree or continue to carry your clubs over your shoulder. Using a clothier's dummy as a model, engineers prove the fact by firing artificial lightning at an especially grounded club—without harm to the model.

LIGHTNING STRIKES FROM GROUND



Lightning jolts New York's Empire State Building. Strikes, which have reached as high as 48 in a single summer, may become slightly more frequent as the result of the addition of a 222ft television antenna to the 1250ft building. Addition of the antenna will also give lightning protection to a slightly wider area.



A 15,000,000-volt flash of artificial lightning, most powerful lightning ever made by man, spans the gap between two high-impulse generators in General Electric's high voltage laboratory in Pittsfield, Mass.

Did you think you saw a bolt from the sky strike nearby during that last thunderstorm? Lightning scientists at General Electric's high voltage laboratory here say that you didn't. Actually, according to Julius H. Hagenguth, director of the laboratory, you saw a flash travelling from the earth toward the clouds at a rate of about 18,000 miles per second.

HE says that as a lightning charge is building up in the clouds, an opposite charge is building up on earth. The stroke travels slowly from the clouds, invisible to the naked eye. When it contacts the ground, the brilliant portion of the lightning flash which we see spurts from the ground toward the sky.

That's one of the basic facts about lightning which lightning scientists have used in conducting research into one of nature's most awe-inspiring phenomena for more than a quarter of a century.

An aura of mystery still surrounds lightning, but Mr. Hagenguth, and his predecessors who pioneered in lightning research—Charles P. Steinmetz, the famed electrical wizard, Frank W. Peek, jun., and Karl B. McEachron—have lined up enough data to explode some old shibboleths and lay down scientific axioms that may help you from becoming one of the many killed or injured each year as a result of lightning strikes.

SOME FALLACIES

One misapprehension about lightning causes many householders to rush from switch to switch, dousing lights, radios, and appliances with the advent of an electrical storm.

The results aren't worth the bother, according to Mr. Hagenguth.

"An electric discharge which has jumped from two to eight thousand feet to reach earth will not be stopped by the turning of a switch which will make a separation in a conductor only a fraction of an inch in width," he says. "Damage can, however, be prevented in most cases by proper application of lightning protection."

Another popular error, perpetuated even by some science teachers and books, is the belief that a lightning rod will prevent lightning from striking by warding away the negative bolt with positive charges from the earth.

Don't believe it, says Mr. Hagenguth.

Actually, the lightning rod will intercept the lightning, prevent its flow through the vulnerable structura points of the building, and convey it safely away to the ground.

Although it won't frighten the lightning away, the lightning rod, a standby in Ben Franklin's day, is stil the homeowner's best protection against the ravages of lightning.

Some additional tips on how t

void becoming a human lightning od during the next electrical storm:

Stay out of water, be it the bath ub or favorite swimming spot. Water s one of nature's most efficient ghtning conductors.

Avoid open fields. If a surprise hunderstorm catches you on the golf ourse, take shelter in a building. If o building is available, you'll be afer, though damper and dirtier, ying on the ground.

DANGER WITH TREES

In any event, do not take shelter nder an isolated tree. Not only is here danger of being struck by a harge jumping from the tree to the erson, but there is also the possiility of being fatally injured by the urrent as it leaves the roots and asses through the ground.

If you're travelling in an all-metal ar when a thunderstorm approaches, tay in the car. If you must get out, void having one foot touching the round, while the other touches the ar. You'll make a good conductor rom the metal car to the earth.

Keep away from electrical fixtures, ghts, telephones, radios, television ets, and other conductors of elecricity during an electrical storm.

No matter what the precautions, ou can't be absolutely safe, howver. Benjamin Franklin advised esting in a cloth hammock, susended by silk cords equally disnt from the walls, floor and ceilg.

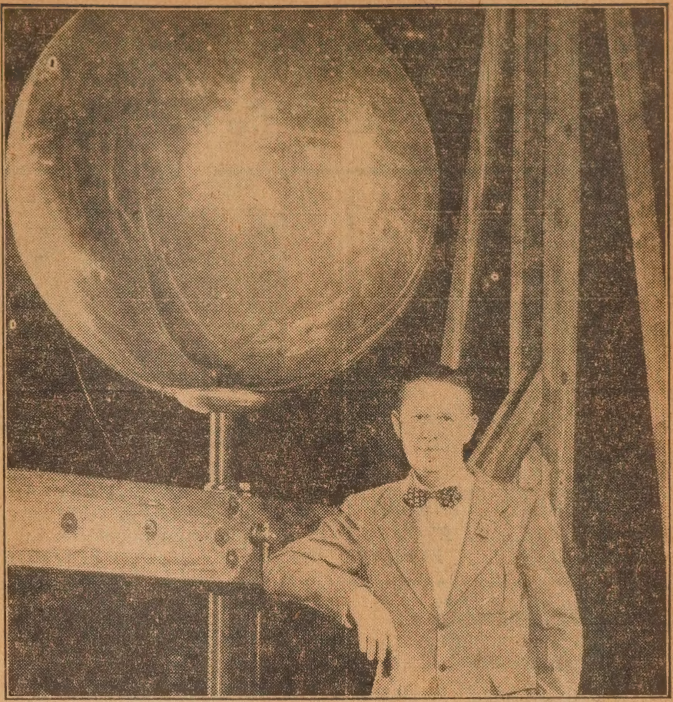
RANKLIN RIGHT

Franklin had the right idea, Mr. agenguth said, but should a bolt f lightning travelling down a conuctor on one side of the room elect jump to a better conductor on the pposite side, it will strike anything its path, including the man in e hammock.

Then there's that old saw about ghtning never striking twice in the ame place. Mr. Hagenguth scotches at familiar phrase with the observation that New York's Empire State Building has been struck as many as 48 times in a single summer.

He also noted that the giant skyscraper may become somewhat more susceptible to lightning strikes with the addition of a new 222ft high television antenna atop the 1250ft building.

The building, which acts as a giant lightning rod for smaller buildings in the immediate area, should give protection to a slightly wider area as the result of the antenna addition.



Julius H. Hagenguth, engineer in charge of the General Electric Company's high voltage engineering laboratory, Pittsfield, Mass., stands before one of the giant spheres of a "sphere-gap" measuring device used to determine voltage magnitudes.

RCA COLOR TELEVISION ACCLAIMED BY PRESS

Following large-scale field tests in July, the RCA compatible color television system was widely acclaimed by the US daily press. Color pictures were voted as better than the CBS broadcasts, while reception on black and white receivers gave sharper pictures than standard monochrome transmissions.

THE *Washington Evening Star* said:

"Any random but unlikely hought that the color television ontroversy has been settled was ffectively banished here yesterday. he Radio Corporation of America, n the first of a series of field tests, howed off the latest version of its nted TV and its pride was jusfiable."

Summing the tests for the *New ork Journal American*, Jack 'Brien says:

"No sense beating about the rainow—yesterday's field tests of color elevision by the Radio Corporation f America's all-electronic system vas good; in fact, very good.

"Comparisons being possibly odious, but at the same time necessary and pertinent, let's also say that the RCA colorcasts were far superior to the ones which already have received the official approval of the Federal Communications Commission. Meaning, of course, the one in operation commercially by the Columbia Broadcasting System.

"The advantages seemed almost ridiculously evident; the drawbacks non-existent. The colorcasts, beautifully pictured and presented in showman-like fashion, trailed no color messily at the edges as the CBS system does. No flare dazzled uncomfortably when the eyes were pulled away from the picture itself, as channel 2's tinted TV unfortunately does."

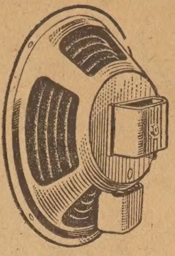
The *New York Herald Tribune* reported that . . . "An estimated 1,000,000 television set-owners in the New York metropolitan area saw a color television broadcast in black and white yesterday as the Radio Corporation of America made its first bid for public support of its color video method."

The compatability feature made a tremendous impression, along with the quality of the black and white version of the broadcast. The *Wall Street Journal* reported:

"At the Press showing, it was obvious that the black-and-white reception was much better than normal, with sharp definitions and no fogging or blurring."

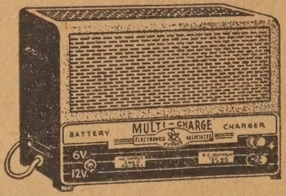
The WARBURTON FRANKI Page

Everything for the Radio Hobbyist—Check it each month



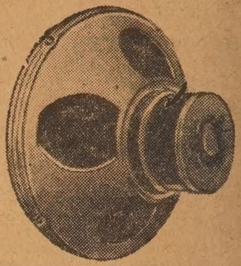
JENSEN 12" PERMAGNETIC SPEAKERS

Heavy Duty	**£5/18/-**
Medium Duty	**£4/6/7**



Multi-charge Battery Charger

The only selenium type to charge at both 6V 4A and 12V 4A. New Model features pilot lamp to indicate when battery is fully charged. **£14/10/6**



GOODMANS HIGH FIDELITY SPEAKERS

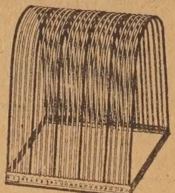
Axiom 150 12" twin cone	£19/5/-
Audiom 60 12" single cone	£15/10/-

PORTABLE GRAMOPHONES

by Goldring fitted with Garrard motor, leatherette case with record and needle holders **£16/10/-**

GOLDRING NEEDLES

Sapphire straight, trailer, or miniature	13/6 each.
Steel Needles	2/3 per 200
Radiogram Needles	3/- per 100
Shadow Graph Needles	5/3 per 100
Miniature Steel Needles	6/- per 24
ACOS GP9 Unbreakable Cartridges	39/- each
Lidstays 6" Florentine Bronze	5/1 each
Record Cleaning Pads	4/9 each

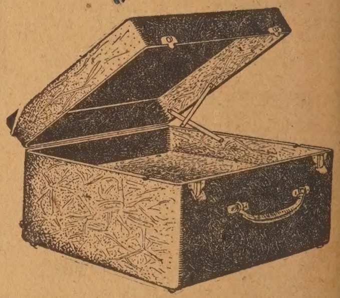


RECORDEX

The new improved Gramo record rack.

- Holds 25 10in or 12in records.
- Engraved easy to read index strip.
- Complete with index card and gummed identification numbers for the records **25/-**

New model now available to hold 50 records **33/-**



RECORD CHANGER CABINETS

Suitable for any make of record changer. Brown leatherette finish **153/2**

Similar, but for single player motor and pickup **126/3**

Small De Luxe type for Garrard "S" type motors **113/9**

"MYTI" DISPLAY TURNTABLES

8" carries 112lb	**£13/4/-**
12" carries 175lb	**£19/9/8**

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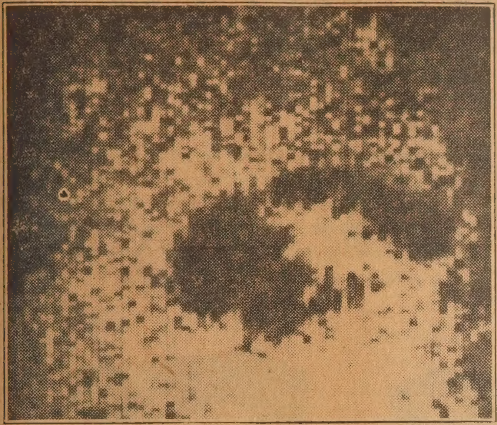
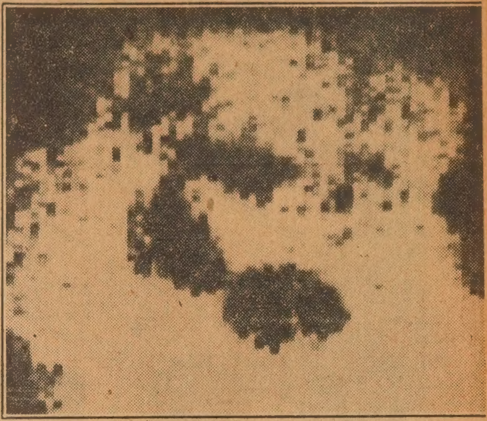
ULTRASONICS EXPLORE THE BRAIN



A normal human brain, taken by Ultrasonics. The dark shadows in centre of the picture are the normal inner cavities, the so-called ventricles. These can be seen in the Ultrasonics picture without any special preparation. An x-ray picture requires a preliminary surgical operation to fill these cavities with air.



A brain tumor. The inner cavities are altered. Upper left, a round shadow, the tumor. Its location is determined and the patient can be operated upon with confidence.

Because of its intricate nature, brain surgery is generally accompanied by some degree of risk, making it highly desirable for the surgeon to know as much about the case before he operates. This article tells how ultrasonics has been used to locate and pinpoint affected areas prior to surgical treatment.

THE term "ultrasonics" refers to sound waves which are beyond the limits of ordinary hearing but which may be generated and detected quite readily with suitable equipment.

In many cases this differs very little from ordinary sound equipment used for music and voices, except that a cathode ray oscilloscope or some other mechanical method must be used to "hear" the sounds, or more accurately, to register them.

The normal range of the human ear lies between approximately 16 cycles and 14,000 cycles, although some young people with sensitive hearing can detect sounds up to 20,000 cycles. Some animals can hear higher than this, the classic examples being those of the dog, which will respond to a whistle which is too high in pitch for humans to hear, and bats, which allegedly guide themselves through the air by means of very high frequencies emitted on the radar principle.

When produced with sufficient power ultrasonic waves are able to generate heat, emulsify solutions, and in cases can prove most destructive and even dangerous to life. According to the exact frequency used, they are also most penetrating.

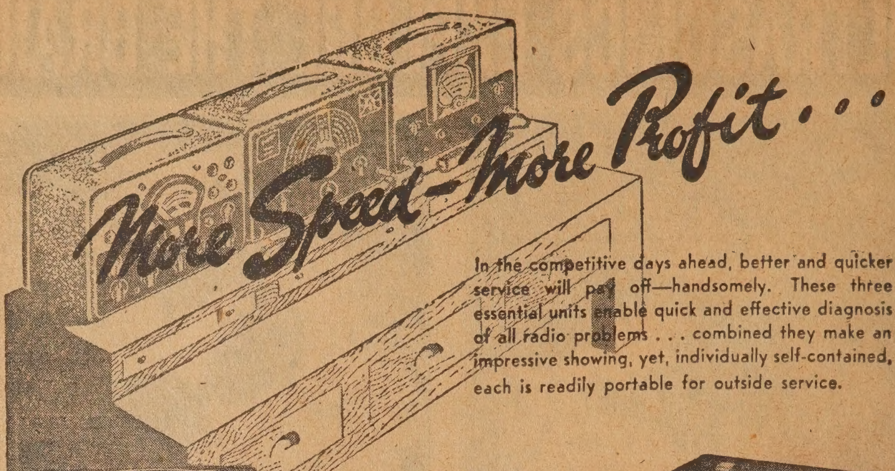
Ultrasonic waves are frequently used to detect flaws in solid objects by applying them to the exterior in a series of pulses. Any discontinuity in the object, such as a flaw, will reflect some of the sound waves back to the surface, where they can be detected with an oscilloscope.

A similar method is now being used by Dr. Theodor Dussiks, of the Salzkammergut Hospital, in Switzerland, to detect tumors of the brain. These are quite difficult to locate by means of x-rays, which require that the skull cavity can be filled with air, a difficult and dangerous process.

In Dr. Dussik's process, the patient lies at full length on a bed, with his head inserted in a special basin, enclosing the upper part of the skull. The basin, filled with

(Continued on Page 55)

The patient lies on the bed, with the apparatus in position. Around his forehead may be seen the rubber gasket. The upper part of his skull is immersed in water, through which the Ultrasound is projected. As this beam does not "diffuse" the picture will be sharp.



In the competitive days ahead, better and quicker service will pay off—handsomely. These three essential units enable quick and effective diagnosis of all radio problems . . . combined they make an impressive showing, yet, individually self-contained, each is readily portable for outside service.

PALEC MODEL V.T.M. (Probe) MULTIMETER

Ranks as most versatile and valuable single piece of test apparatus. Checks and tests all circuits, R.F., A.F., A.V.C., under operating conditions without disturbance.

Capable of quickly locating most obscure and elusive of intermittent, noisy, open or short circuits. Checks all component parts and tests for high resistance insulation leaks.

Used with Model M.O. oscillator or equivalent, traces signal and determines stage gain in every channel from mixer to speaker.

Ranges: (1) R.F.-A.F. six-range volt-meter: 0-2.5-10-25-100-250-1000 volts A.C. Fitted with polystyrene bushed probe operating on frequencies up to 300 M.C. accuracy plus 0.5 db. to 100 M.C. Input cap., 10 uuf., loading equal to 6 megohms. (2) High resistance D.C. six range volt-meter: 0-2.5-10-25-100-250-1000 volts D.C. Total load 11 megohms—giving over 4 megohms per volt on lowest range. (3) Ohmmeter, six-range—from 0.5 ohms to 1000 megohms.

Detachable co-axial leads, 20 page instruction book supplied. Employs 4 valves.

PALEC SIGNAL GENERATOR MODEL S.G.I.

Frequency Coverage: 150 Kc/s. to 30 Mc/s. in six overlapping ranges Accuracy, 1%, Individual coils permeability tuned and fitted with air dielectric trimmers Vernier dial.
Output: From 0.5 microvolt to 1 volt. Accuracy within 2db at all frequencies. Detachable universal dummy antenna.
Modulation: Internal—400 cps. variable 0-100%. External—Uniform response with 1db from 30 to 10,000 cycles, 2 volts required for 30% modulation, 5 volts 400 cycles signal available externally with less than 2% distortion. Frequency modulation negligible.
Leakage: Less than 0.5 microvolt at 30 Mc/s., decreasing at lower frequencies. Triple shielding incorporated.
Attenuator: Ladder type of unique construction with 10 ohm nominal impedance on all but the highest output ranges. Attenuator has negligible effect on carrier frequency.
Valves: 2-6SN7; 1-1852; 1-6X5
Dimensions of case: 14 ins. x 8¾ ins. x 8½ ins. Weight: 29lbs. Available for 220-260 volt A.C. and external vibrator operation.

NEW PALEC VALVE TESTER, MODEL V.C.T.-2

A new Valve and Circuit Tester—10,000 ohms per volt—is a worthy successor to the well-known Model VCT which since 1937 has been Australia's best-selling radio-test instrument. A.C. operated either from 200-260 volts or operated from the battery by using external vibrator.

Features

Fitted with large six-inch, 100 microamp. sector type meter. A new release.
Housed in our standard size steel case to match other instruments in the Palec range for a neat bench display. Also portable for outside work.
Full floating element selector switching obsolescence free.
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TV STARS IN BRITISH EXHIBITION

Britain's 18th Radio and TV Show began in style on August 29. Lord Louis Mountbatten, in sober civilian clothes, declared it open, and a band of trumpeters dressed as heralds gave the fanfare for the show to start in the lofty concrete wastes of Earl's Court. After that the serious business of dispay and sales-booking went on until Setpember 9, just catching the last of the Festival crowds.

☆

Special from London

☆

Smallest TV receiver was this GE bedside model with a 2¾in picture. Set is 10 x 8 x 7 inches.

THE size of the show is staggering, with more than 230 displays to see. Everywhere the stands have been cleverly and imaginatively designed. Furniture and fittings have an excitingly new look and concealed and trick lighting is used to catch your interest, but technically there is not very much that is fundamentally new, nor a great deal that is changed in the frills of the fairly old.

Mostly, it is a TV show, with radio sets a rather poor relation. The bigger distributors have darkened corridors at their stands, where television sets with 12, 16 and more rarely 21 inch screens are shown.

The prices grow with the size of screen from about £90 sterling to £150 for the smaller and up to £500 for the luxury types; but at least here one can look for nothing, and the booths are crowded.

Mullard, Phillips, Peto Scott and a few others feature a flat projection screen that removes many faults of the direct vision curved type. They use a small 2½-inch CRO, and with a lens system and a mirror project an enlarged image on to a vertical screen of special optical qualities. The result is a picture of 17 by 12¾ inches and without the emphasised horizontal lines that large CRO direct vision sets give.

NO COLOR

The screens also introduce softer tints and avoid the typical green glare of the direct vision types. Shown side by side the prize for easy viewing goes to the projected vision types.

None of the makers mention "color television," and PYE, of Cambridge, when asked said they were the only ones known to be experimenting and they had no hopes of anything commercial for at least 10 years. Baird Television have a small museum of instruments that the great James Logie built before his invention ran away from him, and display a contemporary set of their own design.

The humble radio sets show no extravagant designs and are becoming unassuming in appearance. Portables have gone gay in handbag shapes with tartan trimmings and top handles. There are rather few radio and TV sets combined and these are dear. Radiograms on show are mostly luxury liners of up to £300, but most even of the small ones have two and even three speed motors for 78, 45 and 33 rpm.

Most of the magnetic recorders are the tape variety, and Bairds show one using plastic tape which automatically expunges the old recording as you make the new. Price £60, mike included.

There are lots of interesting small exhibits. GEC plump for their new Germanium crystal rectifiers and show a test set using crystal amplifiers of quite fair gain. They suggest the possibility of the all-crystal-valve receiver needing no filament circuit and no LT supply. Even the London *Times* was moved to comment on this.

Vidor Ltd., of Kent, have a new dry cell based on the Mercuric Oxide-Potassium Hydroxide-Zinc* system, and they say it has four to seven times the life of the old types, with no appreciable voltage drop over its whole useable life. So far only high priority users can get them.

Radar somehow gets by-passed. The Admiralty show a naval radar plotting room and the RAF demonstrate H2S as a navigation system, but the commercial producers have not exhibited it. The "Hams" have been overlooked mostly, and none of the exhibitors makes any appeal to the visiting "Ham" by displaying kits or special sets to any extent.

BBC EXHIBIT

The biggest attraction is the BBC. They have set up a complete television studio and you can file around its soundproof glassed walls and watch the show and the televising. Microphones swing at the end of long levers, frighteningly like the complicated dentist's drilling gear; men swing and sway on elevated chairs and sit on trolleys that seem dangerously to bear down on the performers, but suddenly reverse as the actor makes a forward movement. There is a tremendous mess of performers and technicians, the latter distinguishable mostly by their headphones. The crowd love it and refuse to "move along, please."

Phillips also draw crowds with a demonstration of remote control of model ships by radio. They launch planes by catapults, lower and pick up lifeboats and manoeuvre cleverly, all "no-hands." Eyes are open wider here than anywhere else at the show.

RESEARCH

On the second floor, and well away, the GPO show how radio and TV interference can be minimised. The Radio Research Board also shows a complete ionospheric recorder unit continuously bombarding the layers of the upper atmosphere with three microsecond pulses of 30kw and recording the echoes on a continuous film strip. The data they get here and at several other stations is used in predicting radio transmission conditions and calculating maximum useable frequencies. It is a bit too technical and unexciting for the crowd, which hovers nearer to the TV studio and the BBC broadcasting stand, where popular announcers have to do penance signing autograph books.

The Board of Trade has a rather lonely stand near the exit and, although few people look at their statistics, they are interesting. In 1950, they say, Britain exported £17-million worth of radio equipment, and in 1951 this reached an all-time high of £21-million.

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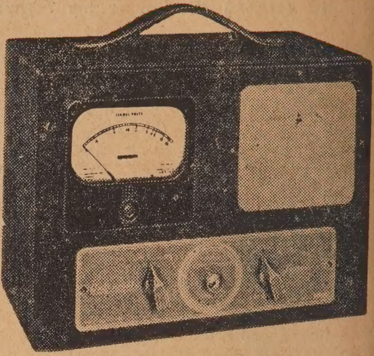

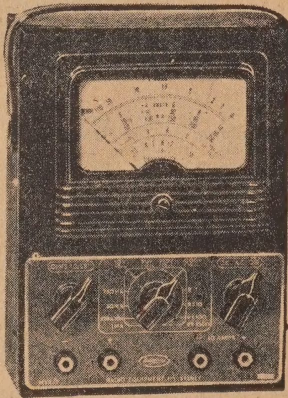

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COMMENTS ON POPULAR SCIENCE

I have some very interesting things to write about this time, because I have been sitting in the train opposite a most beautiful lady. I so wanted to tell her that the color of her blue eyes was due to the absorption of various parts of the spectrum of which daylight is made.

by Professor A. M. Low

SURELY she would have been interested to know that blue is one of the short wave-lengths, and that it approached the violet which is so useful when one wants to take a photograph? Not at all like the heat waves from a gas stove.

For some queer reason it is considered essential in all the best novels to say that somebody's eyes turned black or green as their emotions varied.

This is, of course, just nonsense, because an eye out of its surroundings is not a pretty thing and, if this lady had had coloring matter round the pupil through which the light passed to the photographic camera or retina at the back resembling violets in springtime, the effect would have been really ugly.

Nasty little red streaks would be terribly out of place.

ROMANTIC SARDINES

A much more romantic thing to have said would have been that an empty sardine tin upset in a puddle of dirty water reminded me of her eyes. Now, wait a minute. I am quite serious.

When the thin film of oil spreads over the water, it interferes with light vibrations and if the film is thin enough it will absorb all of them so that it looks black.

If it is not quite so thin, nothing in the world could surpass the blue iridescent violet which you can see in any puddle when a leaking motor car crankcase has passed by.

I shall not tell you what happened, but it did occur to me that thought is an electrical process giving rise to etherial oscillation, and I begin to wonder how long it will be before thoughts are capable of reception by some apparatus.

It would be a blessing if we could pick up ideas in this way without the vulgar preliminaries of hand-shaking and lip-wagging which oscillate the air to produce speech.

Noise is a vulgar thing which we should never inflict on other people any more than unwanted touch or smell.

NOISES

I will admit that some regular noises which become sound can be quite pleasant. No doubt it is due to the manner in which we obtained our meals millions of years ago when we existed in protoplasmic form on the seashore.

Rhythm of the tides fed us, and from that dim period we have been creatures of rhythm which breathe by habit at the same speed, absorb light at a definite speed and have hearts which beat like some form of savage music.

That was long before the days when men wore a moustache to filter insects as they drank from a stream!

I suppose you know that when a butterfly sits on a bridge it bends? I mean the bridge, not the butterfly, although no doubt it is mutual. There is a kind of measuring balance so delicate that if it is attached to a 4in deal plank about 3ft long and a half-penny is placed at one end, the instrument will indicate that the wood has been bent very considerably.

Apparatus to increase the sensitivity of your own perception is very important in science. One interesting example is called a thermopile, an arrangement of different metals such as antimony and bismuth in contact and connected to a delicate apparatus for detecting electric current. Heat causes a current to flow.

TEMPERATURE

Many years ago Professor Boys concluded that if the planet Jupiter was as hot as boiling water it would be possible to measure its temperature by a thermopile of this character.

These little machines are so delicate that it is easy to detect the heat of a candle one mile away, and I am told, although I was not present at the time, that it has measured the heat of a girl's cheek when she blushed.

It might be difficult to make this experiment nowadays, not because thermopiles are hard to make but because blushes . . . I will leave the rest to your imagination.

I expect you know in these days of atomic destruction that all substances, if you had microscopic seeing eyes, would seem to be more or less hollow. Electrons and atoms buzzing round interminably, buzzing quicker when the material is hot, slowing down at freezing, and looking most queer in the case of substances like wood.

There is far more space than wood in a piece of wood. Keen enough eyes would show you a plank of oak looking like the Milky Way.

It is this idea that is being extended in the search for strong and better materials, and it is true to say not only that a spider's web is far stronger than most man-made steels, but that if we knew how to imitate the strength of ultra-microscopic particles of steel which live, as it were, inside the harder metal, it would not be impossible to make it quite 20 times stronger.

I seriously believe that in a few centuries' time the size of things used today will seem ludicrous to the children of that era.

We use thick girders because we do not know how to make them strong when they are thin. We use thick motor-car tyres because we have not yet learned how to make a steel-like skin flexible and with a thousandth part of the weight now so necessary.

If wheels could only be made much thinner, road springing would be far better and the wheel would bounce on the road, following its contour, while you sat lazily and happily in the back.

This point of size reminds me of an amusing question once put to some students. "Tell me, gentlemen," said my friend, "what would you first notice if you woke up and found everything in the world 20 times the normal size?"

The answer, of course, is *absolutely nothing*, because if everything was bigger you would have nothing with which to make your relative comparison!

The subject of weight is rather interesting, for it is, of course, due to the earth's attraction. Now, in addition to the earth attracting things to it, the earth is also attracted to the things.

WEIGHT

Drop a stone and the stone falls to the ground, but do not forget that the ground also moves toward the stone. I will admit the movement is very small. Many things in this world are small. If I thump on the table in London it rattles the teacups in Australia, but so slightly that neither you nor I would notice.

To come back to earth, our happy world is revolving exceedingly fast, and there is a tendency for everything to be thrown off exactly as in the joywheel. But for gravity we would fly away like the ball in roulette.

Now the line of the equator, being longer than a smaller line nearer to the poles, is clearly moving faster, just as the rim of a wheel travels quicker than the hub. So anyone standing on the equator is being thrown away against the force of gravity more strongly than another man in Alaska.

It is probably true that if you want to break the high jump record, other things being equal, it would be better to attempt this feat on the equator.

One pound of tea weighed on a spring balance varies all over the earth, but no one has yet thought of setting up a chain of stores around the equator to make good use of such a business-like state of affairs.

A remarkable x-ray picture showing a broken knifeblade which had been in a man's brain for 14 years after a fight with bandits.

LIGHT—SEEN AND INVISIBLE

To most of us the word "light" signifies some form of visible illumination. That this is not an accurate definition will be seen from the following discussion.

by Calvin Walters

MY dictionary defines light as, "A form of energy consisting of vibrations in the ether which act upon the optic nerve and make vision possible."

Although this is a fairly modern dictionary, the definition is not adequate enough to cover all the facts known today.

When an astronomer directs his telescope toward a far distant star all that he does is to concentrate all the light falling on to the mirror into a very small point.

This is done by the concave shape of the reflecting mirror and by the arrangement of the other optical parts of the telescope.

MORE LIGHT

In effect, the eye of the astronomer sees that which he could see were the pupil of his eye as large as the mirror. The optical arrangement of the eye would in such a case concentrate the light on to the retina in the same amount as the large mirror does for the astronomer.

The eye, when looking through a telescope, does not see distant objects because the telescope has magnified them. It sees them because a large enough quantity of light from the object has been concentrated into a small area.

According to what is called the "Quantum Theory" radiation is propagated through space in units of uniform value called "quanta." For proper vision a certain minimum number of quanta are necessary.

Visibility is not possible unless the retina of the eye receives this minimum number of quanta because the optic nerve is not sensitive to a lesser number. The number of quanta required for vision varies according to the color of the observed light.

Although the most distant star clusters and galaxies must shine in their immediate vicinity with an intense luminosity they are so far away that the eye cannot see them, even with the aid of the large 100-inch telescope mirror on Mount Wilson, USA.

It has been estimated that the most distant of these galaxies are 500-million light years away. This is the number of miles obtained by multiplying the number of seconds in a year by the speed of light—186,000—and again multiplying this by 500-million.

This is an immense distance and the amount of light reaching a given observer is that which would be given from a candle at a distance of approx. 8000 miles. In other words, the unaided eye cannot see it.

The 100-inch mirror intercepts only 500 quanta of this light per second and as this number of quanta is far below that required to activate the optic nerve, the eye, even with the aid of the large telescope, cannot see the light given from these galaxies.

How, then, do we record the light? This light clearly must be invisible and if it is proved that it does exist it will be the first proof of my statement at the beginning that the dictionary definition is not adequate.

PHOTOGRAPHING STARS

The light from these galaxies has been observed by prolonged exposure of a photographic plate to the rays, as intercepted by the 100-inch mirror on Mount Wilson.

The remarkable advance of photography in the past twenty years has enabled us to penetrate farther and farther into the realms of invisible light.

There is a story told by G. W. Gray of a gathering of businessmen in the Kodak Research Laboratories, who came to witness the latest developments in modern photography.

The men were seated in a little theatre when a voice asked all to remain still a moment because their picture was to be taken. The lights were suddenly extinguished. All present expected a sudden flash from a flashlight, but none was forthcoming, and after a few seconds the lights were put on again.

A few minutes later the still damp prints of the photograph were distributed to the guests.

INVISIBLE LIGHT

Here indeed was a new magic. The director of the laboratories explained that there were actually light waves in the dark room of such a long wavelength that they were invisible to the eye, but not to the special photographic plate used in the camera.

Hidden lamps in the room bathed

the spectators with invisible heat rays. It was to these rays that the photographic plate was sensitive.

Infra-red photography as it is now called, is now an established practice and today, does not astonish us so much.

The human eye is blind to all radiation extending below the violet and above the red in the spectrum. As we proceed below the violet the rays become shorter and invisible while above the red the rays become longer and invisible.

Blue light has a wave-length of some 15-millionths of an inch and red light 30-millionths of an inch so that between these two wave-lengths lies all our visible illumination.

As sensitive as man's eyes are to changes in wave-length and intensity of illumination he can see only about one sixtieth of the range of radiation which we know exists in the universe.

This, of course, is a very happily designed arrangement.

NO DARKNESS

A little thought will convince anyone that there would be serious disadvantages were our eyes able to tune themselves to all known kind of radiations.

Our vision would be aflame with the infra-red radiation from our own eyelids whether our eyes were open or closed. There would be little chance of rest or sleep.

Cosmic ray sensitivity would probably expose our pockets and insides to the prying eyes of our neighbors, our landlords and the income tax collectors.

The postman would read our letters without removing them from their envelopes, the vaults of banks would reveal their contents.

To New South Wales residents there would be some compensation. The Electric Light Company would be furious if they couldn't give us any blackouts.

It is thus seen from a consideration of the above facts that there is no real darkness. We are surrounded by so much radiation which may be made visible by photography that nothing really remains unseen.

The fact that infra-red rays can activate special photographic emulsions has greatly aided the astronomer in his efforts to penetrate the secrets of the sun and stars.

The spectroscope has been the instrument mostly used in such enterprises. This instrument throws a spectrum of the light from a given star and this spectrum is photographed on the special plate.

Examination of these spectra can reveal the composition of the stars in question because hot gases of various elements which exist in the atmosphere surrounding the star will throw lines in the spectrum in definite positions which enable the astronomer to identify the element.

Previously, when he had no photographic emulsions which were sensitive to infra-red radiation, astronomers were confined in their investigation to the visible spectrum from red to violet.

Many of these line signposts of the spectrum are situated in the invisible regions beyond the violet and red.

Those which are beyond the violet are not of much use as they are largely absorbed by the atmosphere, but those beyond the red are now of great use as they can be photographed on the infra-red photo plates.

By such means the presence of phosphorus in the sun was made known.

In regard to the planets, infra-red has also aided the astronomer. Planets have no light of their own and shine only by reflected sunlight.

When, however, the light from the sun falls upon a gas like our own atmosphere certain wave-lengths of sunlight are absorbed by the gas.

The resulting spectrum shows certain dark spaces in positions which, in the spectrum of direct sunlight, are occupied by colors denoting certain elements.

These dark spaces in the planetary spectrum show that the elements corresponding to the colored lines in the same position in the sun spectrum are present in the planet.

This method was used to prove that the atmosphere of Venus contained 10,000 times as much carbon dioxide as the earth's atmosphere.

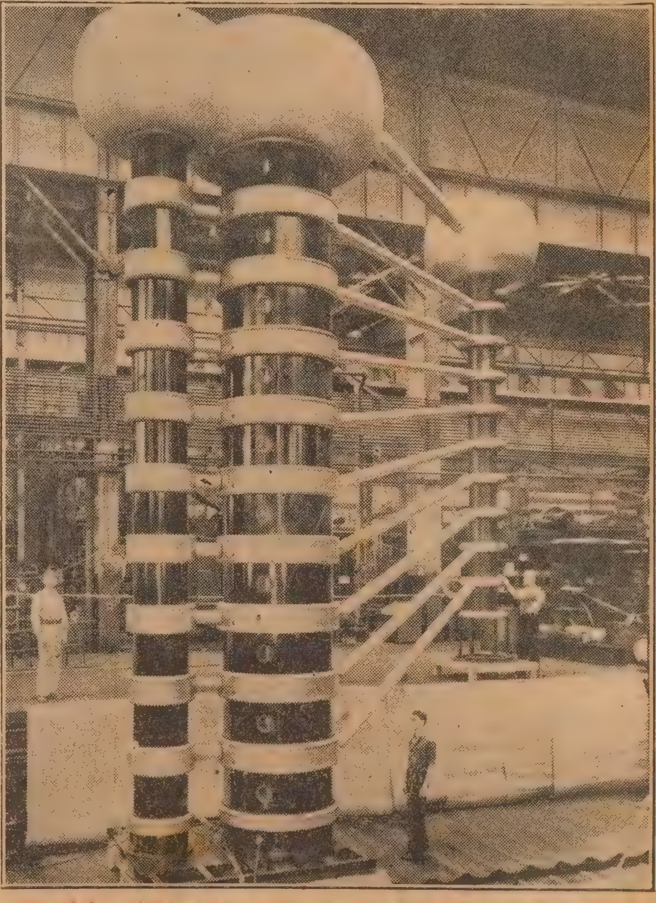
It also showed that the atmosphere of Mars contains only one quarter of one per cent that of the Earth's atmosphere. Likewise Jupiter and Saturn were found to contain ammonia in their atmospheres.

Such revelations brought about by the photography of invisible light such as infra-red rays have, in turn, brought further speculation regarding the origin and formation of the Universe.

For instance, the fact that Jupiter and Saturn contain ammonia and methane gas in their atmosphere has caused Dr. Walter Clark to speculate along these lines:—

"Ammonia is a very reactive gas consisting of nitrogen saturated with hydrogen. Methane consists of carbon saturated with hydrogen. Both these gases are stable and it is possible that collisions of atoms in the atmospheres of the planets have continued over vast periods of time until eventually these most stable constituents have survived. It has been suggested that methane and ammonia are just the gases which would be expected to form if a mass of gas having a composition like the atmosphere of the sun were allowed to cool slowly to a very low temperature."

(Continued on page 89)



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Technical Review

A MINIATURE MAGNETRON FOR VHF RECEIVERS

A miniature magnetron is almost a contradiction in terms. Usually we think of pulsed transmitting tubes delivering hundreds of kilowatts. A magnetron for an ordinary TV receiver which works with less than 200 volts seems almost unbelievable. Yet such a tube has been constructed.

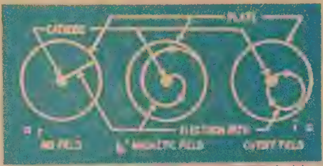

Fig. 1 — Effect of the magnetic field.

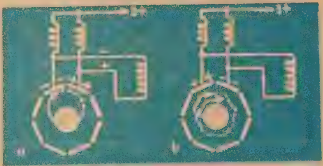

Fig. 2 — How oscillations are produced.

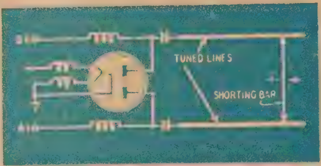

Fig. 3 — Practical circuit for the tube.

THIS tube may be an answer to the problem of finding a local oscillator for TV receivers operating in the 480-890 Mc band.

Triodes have been used in that spectrum, but their efficiency drops off sharply at higher frequencies. Cathode, grid, and plate spacings are so small that the tubes are difficult and expensive to make.

The Klystron works well at ultra-high frequencies, but is tunable only over limited ranges, and is even more expensive than ultra-high-frequency triodes. So there is definitely an opening for an ultra-high-frequency receiver oscillator. The new magnetron, experimentally designated as the G-E Z-2061, has been designed to fill that opening.

The magnetron has several advantages for such a job, because it is a very simple tube. The Z-2061 is a diode with eight plates connected alternately to two end rings. Manufacturing costs are lower than for the more complex tubes. Tolerances are less rigid, as cathode-grid and grid-plate spacings can be relatively large in a tube that will work above 1000 Mc.

HOW IT WORKS

Oscillations in a magnetron are not produced like those in standard vacuum tubes, though there is a similarity between them and Barkhausen-Kurz oscillations.

A simple magnetron with a single cylindrical plate can be made to oscillate, but general practice is to split the anode into a number of segments (these are the resonant cavities, or "keyholes" of the high-power radar tubes).

The Z-2061 has eight segments, or vanes. They form a cylinder 0.18 inch in diameter around a cathode whose diameter is 0.1 inch. These vanes are connected alternately to opposite end rings, forming two inter-leaving anodes of four vanes each.

The magnet used with this tiny magnetron is actually two horseshoe magnets butted together, S-pole to S-pole and N-pole to N-pole, to form a perfect ring, which is put over the tube and turned to the position at which plate current is minimum.

If this magnetron (or any magnetron) is operated as an ordinary diode, plate current will flow to the plate (anode) or plates (fig. 1a). But if a strong magnet is placed with its poles at the ends of the cathode, so that we have a magnetic field lengthwise along the cathode, the electrons are deflected from their straight course.

Each electron is a minute electric current, and is deflected by a magnetic field according to the well-known right-hand rule. (Imagine the thumb of the right hand to be the cathode, pointing toward the N-pole of the magnetic field. Then the electrons, instead of going in a straight line from cathode to anode, will follow a spiral course in the direction the fingers point, as in fig. 1b. Note that the N-pole faces away from the reader).

The strength of the magnetic field can be increased to a point where the electron's path is so curved that it misses the plate altogether (fig. 1c), and curves around back to the cathode. The condition of 1c is called the Hull cutoff point, after A. W. Hull, inventor of the magnetron.

The magnetron oscillator (fig. 2) is a push-pull circuit. In the Z-2061 there are four push-pull pairs, each consisting of two adjacent anode plates.

ADJUSTMENT

The Hull cut-off point may be reached by adjusting the plate voltage (the magnet is a permanent one, so magnetic field strength is fixed). A cloud of electrons is then rotating around the filament.

The very outer edge of the cloud just falls short of the anode cylinder which catches the stray outermost electrons. Other electrons may be forced into orbits that take them back to the filament, as in Fig. 1c. Still others may spiral around the cathode several times before they succeed in reaching either cathode or anode.

To understand how the magnetron oscillates, remember that each electron has a certain amount of energy or momentum due to the attraction of the positive anode on the negative electron.

The magnetic field does not add to or subtract from that energy — it merely changes its direction. It is this energy—taken from the B-supply as in any other oscillator—that is used to maintain r.f oscillations.

A rapidly moving electron can give

(Continued on Page 17)

Left corner, a GE Z-2061; left, two tubes without envelopes; right, an exploded view.

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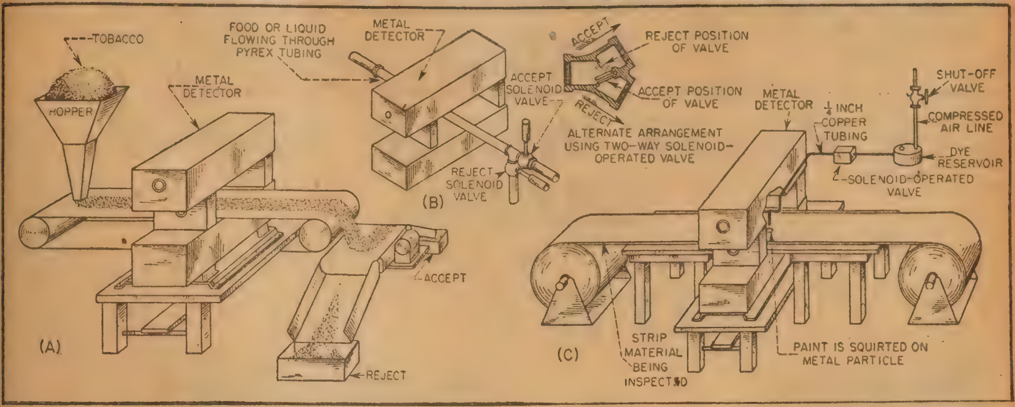

Examples of metal detector applications in three different industries. Conveyor belt arrangement at (A) works well with many other granular materials besides tobacco. For any material that can be sent through a glass pipe, the arrangement (B) is ideal. Strip material like plastic sheet (C) can be inspected for extremely small particles because it requires minimum aperture.

Used originally to locate heavy metal particles in lumber, the technique of metal detection is rapidly invading all branches of industry. Equipment is being designed and data released covering a wide variety of possible applications.

THE heavy applications of metal detection are now fairly familiar in all countries, notably the inspection of lumber before reaching the sawbench and the detection of crowbars, &c., in loads of sugarcane.

Reduced in scale, the same techniques are now being applied widely to detect metal particles in foodstuffs, particularly those which involve passing through grinding and shredding processes.

A recent article in Electronics, by C. R. Schafer, suggests what metal detectors can and cannot be expected to do. He points out that a properly set-up detector can "see" particles which would not possibly be apparent to visual inspection, since they are often embedded in the base material. There is no hazard, either, to the operating personnel, as is the case with some x-ray inspection equipment.

Against this, metal detection devices are often rendered insensitive by the presence of too much moisture, particularly if they need to operate at a high frequency. They must be kept away from moving metal belts or objects to avoid false readings and frequent inspection must be made to guard against unwitting failure of a tube. "Test" samples can be used easily to check the rejection margin.

In selecting a commercial unit for a particular task, it is necessary to know beforehand the sensitivity which will be required, the vibration and stability problems, the speed with which samples will pass the unit, the likely variation in moisture content and also industrial fumes which may possibly affect the mechanism.

Having selected the detector which appears to meet the electrical specifications, a suitable mechanical conveyor system must be designed and installed.

MINIATURE MAGNETRON

(Continued from Page 15)

up energy in two ways. First: It can hit something, and its energy is turned to heat (watch a rectifier tube when the filter blows and the plate is subjected to a heavy electron bombardment); or it can "push" on something, and lose its kinetic energy.

Second: Imagine an alternating r.f. voltage across the push-pull circuit of Fig 2. It is easier to consider that we are dealing with oscillations already started than to go over the laborious process of building them up. (Every radioman knows that, given the proper circuit, oscillations cannot be prevented from starting).

To see how oscillations are produced, all we have to do is to follow two of the electrons in the rotating cloud between cathode and anode. Electron 1 (Fig. 2a) is so placed in the cloud that it finds itself passing the gaps between the anode vanes just at the point in the r.f. cycle when the vane ahead of it is becoming positive and the one behind it negative.

It will be speeded up by the pulling action of the positive plate ahead of it because the plate behind it is relatively much less positive. Since the pushing and pulling by the charges on the anode plates are the reason for its added energy, this electron actually takes energy from the r.f. circuit.

The extra energy it gets causes it to come round the magnetic bend with more speed than average and plunge into the cathode. An electron which is speeded up by the anodes' r.f. field makes one trip only.

Electron 2 has no such easy path. Leaving the cathode about half a cycle later, it finds itself approaching the gap between two anode segments while the plate behind it is positive and the plate ahead of it is negative.

As it travels its circular course, the plate ahead tries to stop it and plate behind pull it back. Pushing ahead against the r.f field, this electron gives up some of its energy to that field.

This electron, having lost instead of gained bounce, does not get back to the cathode as did its speeded-up friend, but may go round the circle once again or several times before reaching an anode segment or dropping back into the cathode.

Fig. 2b is a diagram of the eccentric path of such an electron travelling under the influence of d.c. plate voltage, r.f plate voltage, and magnetic field.

Thus the electrons that give up energy to the r.f. circuit—because they travel longer and farther than those that take energy away from it—supply more power than the accelerated ones take away.

If the difference is more than enough to supply circuit losses, we have an oscillating circuit. We can think of our electron cloud as a sort of toothed wheel or gear which sweeps by the anode vanes, each tooth imparting energy as it goes by.

Various methods of tuning—in fact any that are suited for any types of tubes at these frequencies—may be used.

Lumped constants can be used at lower frequencies (see below). At higher frequencies, long lines, coaxial tuners or resonant cavities are applicable.

The miniature magnetron was designed as a local oscillator for u.h.f television receivers.

It has other possible applications, most promising of which are an oscillator for small transmitters—such as Citizens band equipment—or r.f. source in a u.h.f signal generator. For portable use, we might even have a dry-cell version—though there is no report of anyone trying to make one as yet. ("Radio Electronics.")

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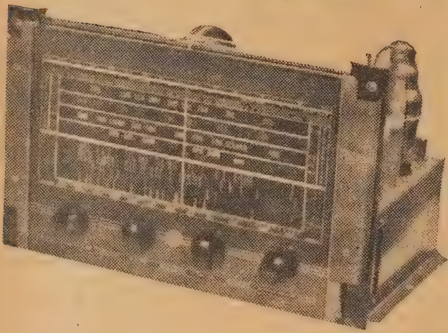

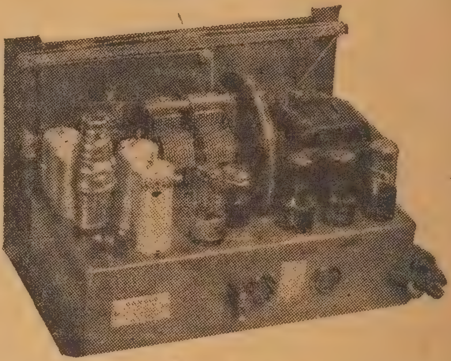

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6 VALVE WORLD-RANGE CHASSIS

SPECIFICATIONS AS EIGHT VALVE UNIT, BUT WITH SINGLE 6V6GT OUTPUT VALVE AND SINGLE 12" SPEAKER.

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CLASSIC RADIO

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PHONE UA2145.

CONTINUOUS FILM SCANNER FOR TELEVISION

Developed by the research staff of the Bell Telephone Laboratories, a new continuous film scanner has automatic compensation for film jitter and flicker, resulting in a much improved signal for television transmission.

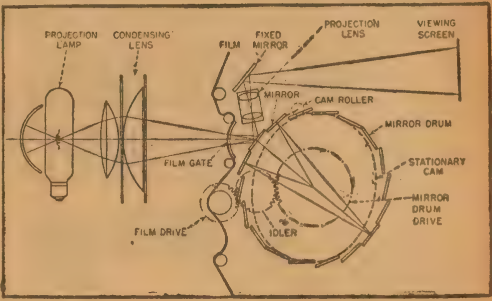
PROJECTION LAMP
CONDENSING LENS
FILM
FIXED MIRROR
PROJECTION LENS
VIEWING SCREEN
MIRROR
CAM ROLLER
MIRROR DRUM
FILM GATE
STATIONARY CAM
MIRROR DRUM DRIVE
FILM DRIVE
IDLER

Figure 1. Elements of the projector when used for conventional projection on a viewing screen. Roller attached to each mirror runs on stationary cam, turns mirror through angle to compensate for continuous motion of film past gate. Projected image contains vertical jitter and flicker.

AMERICAN television stations have generally been considered at a disadvantage when televising standard motion picture films, the images being poorer, in many cases, than those achieved by the BBC on a narrower bandwidth.

One reason for the difference has been that the British stations can synchronise the film frames with the television scanning frames by running the film 4 per cent above normal speed, at 25 rather than 24 frames per second.

The film can be handled by standard intermittent movements of the highest available quality, which hold each frame perfectly still while it is scanned for the television circuit

With the American standard of 30 frames, the same simple approach is precluded, and much attention has been paid to the idea of scanning the film while it is in continuous motion.

INHERENT DIFFICULTIES

Difficulties arise with this scheme because the mechanical interlock between the film images and the television scanning cycle is much less precise than when a synchronised intermittent action is used. A troublesome wandering effect is likely to be evident, which is accentuated if the film shows unexpected or uneven shrinkage characteristics.

A further source of error has arisen from the common use of the iconoscope, whose storage principle of operation results in an inherent loss of contrast.

In the new scanner developed by Bell Telephone Laboratories, this latter objection is overcome by using a flying spot tube as the light source. This tube provides the necessary scanning action and the light transmitted through the film is collected and fed to a multiplier phototube, which produces the initial video signal. In this way, the storage limitation of the iconoscope is avoided and a better picture results.

The mechanical principles of the continuous system can be followed with the aid of the three diagrams.

Figure 1 shows the conventional continuous projector used with an ordinary light source and a viewing screen.

The light, after passing through a condenser system, passes through the continuously moving film on to a series of mirrors mounted around the surface of a spinning drum. The mirrors rock slightly on their mountings and reflect an apparently still segment of the film on to the fixed mirror and the viewing screen.

The limitations of the method lie in the difficulty of maintaining exact control of the film and also in sustaining an even illumination of the screen. The varying angles of mirror tilt tend to produce differing degrees of light intensity throughout the cycle of movement, which results in noticeable flicker when the projected image is scanned for television.

Figure 2 shows how the system is rearranged for use with phototube and a flying spot scanner. It shows also the addition of a servo-control mechanism which uses the image of one half of each sprocket hole to control the apparent image position just as precisely as if conventional stop-sprockets were employed. This servo mechanism promises to solve the difficulties of erratic film behavior.

The second important development offsets flicker of the type mentioned earlier.

FLICKER COMPENSATION

A second image from the flying spot scanner is picked up by a mirror and "angled" through the optical system so that it strikes an auxiliary phototube placed alongside the tube actually generating the video signal.

The auxiliary light signal does not pass through the film, but it does contain the "flicker" component resulting from the action of the mirror drum. This flicker component is used to modulate the intensity of the flying spot, so that the flicker tends to be cancelled. ("Electronics.")

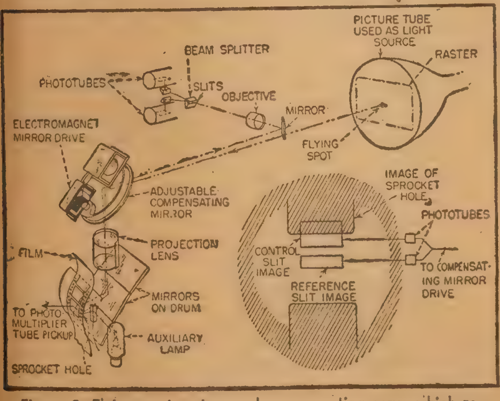
PICTURE TUBE USED AS LIGHT SOURCE
RASTER
BEAM SPLITTER
PHOTOTUBES
SLITS
OBJECTIVE
MIRROR
ELECTROMAGNET MIRROR DRIVE
FLYING SPOT
IMAGE OF SPROCKET HOLE
ADJUSTABLE COMPENSATING MIRROR
PHOTOTUBES
FILM
PROJECTION LENS
CONTROL SLIT IMAGE
TO COMPENSATING MIRROR DRIVE
REFERENCE SLIT IMAGE
TO PHOTO MULTIPLIER TUBE PICKUP
MIRRORS ON DRUM
AUXILIARY LAMP
SPROCKET HOLE

Figure 2. Flying spot system and compensating servo which removes vertical jitter. Image of sprocket holes actuates mirror which rotates as required to compensate for any vertical motion of film frame as projected.

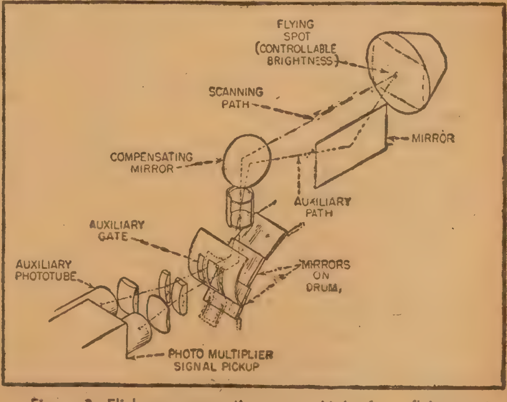
FLYING SPOT (CONTROLLABLE BRIGHTNESS)
SCANNING PATH
MIRROR
COMPENSATING MIRROR
AUXILIARY PATH
AUXILIARY GATE
AUXILIARY PHOTOTUBE
MIRRORS ON DRUM
PHOTO MULTIPLIER SIGNAL PICKUP

Figure 3. Flicker compensating servo. Light from flying spot is reflected from mirrors through auxiliary gate to phototube. Light passing from film changes through active cycle, but servo changes brightness of flying spot proportionately.

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YOU NOW HAVE AN OPPORTUNITY TO JOIN

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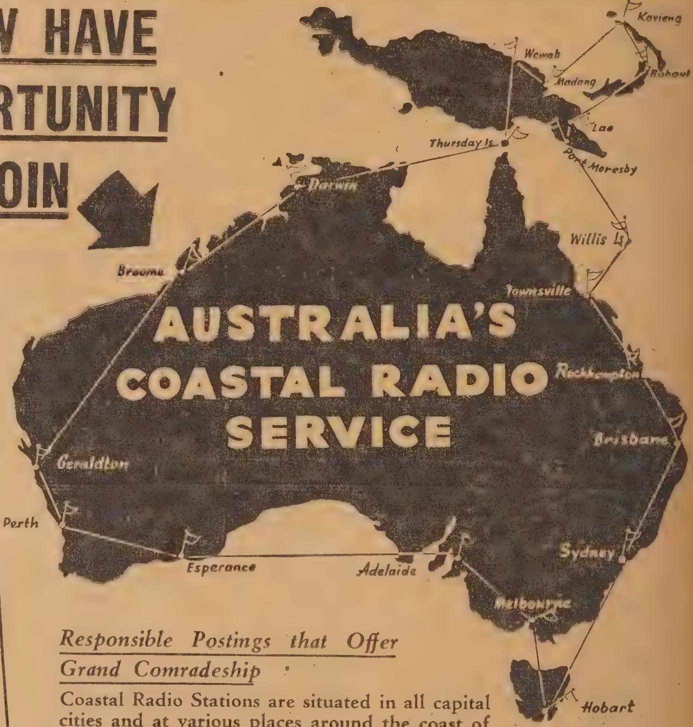

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GENEROUS SICK LEAVE.

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Coastal Radio Stations are situated in all capital cities and at various places around the coast of Australia and in Papua and New Guinea. Grand comradeship exists between the band of Coastal Radio Officers and their wide range of contacts on ship and shore. Applications are invited now from Radio Officers holding 1st or 2nd class tickets to join "Coastal Radio."

District Allowances and Extra Pay for Shift Work, Holidays, Week-end Duty

Initial appointments will be to Sydney Radio, but officers may later be required to serve at northern stations. District allowances at non-metropolitan stations vary between £15 and £175 per annum and are additional to salary. Penalty rates are paid for shift work, week-end and holiday duty. There are staff cottages at Papua-New Guinea stations and non-metropolitan stations in Australia.

For further information call, write or phone.

OTC

THE OVERSEAS TELECOMMUNICATIONS COMMISSION (AUSTRALIA)

Chief Administrative Officer
47 YORK STREET, SYDNEY. B 0544—EXTENSION 317

OTC7.FP.81

NEWS AND VIEWS OF THE MONTH

Those Space Ships

POSSIBLE landing expeditions on Mars reappeared in the news during the month, when Wernher von Braun, a German rocket expert, told a meeting of scientists in London that an expedition could be transported, using chemical fuels already in existence.

Prior to the landing, and as the first step towards it, he forecast a man-made space station revolving round the earth as an artificial satellite.

As soon as this were done, said Dr. von Braun, man could start exploring outer space in earnest. There was no need to await atom-powered rockets, which would probably be many years in development.

DR. VON BRAUN said 46 rockets, built in three steps, which could be discarded once the fuel in each part had been exhausted, could haul the parts for a space ship to an orbit several hundred miles above the earth's surface.

The rockets, each with a takeoff weight of 6400 tons, would make 950 flights to the orbit, where 10 spaceships would be built.

The spaceships would weigh 3720 tons initially, would not require streamlining and would need only low-power motors.

With preparations at the earth end complete, 70 men would then establish another space station revolving around Mars.

Fifty of the men would go on in three small 200-ton rockets to land on the surface, with sufficient supplies and fuel to take-off again after one of the rockets had been abandoned.

LONG JOB

Dr. von Braun estimated that 5,320,000 tons of propellants would be required for the supply operation and 36,600 for the interplanetary voyage.

The whole operation would last two years 239 days, plus eight months' preliminary supply operations.

Von Braun's paper was read by Lieut.-Commander Frederick Durant from the United States naval air-rocket test station, New Jersey.

Durant said:

"Speaking as an engineer, I believe the space station could be established in 10 years if two to three billion dollars were made available."

RADIO & HOBBIES 1/6 NEXT MONTH

BEGINNING with next month's issue, the price of Radio and Hobbies will be increased to 1/6 a copy.

This change in price has been made necessary by rapidly increasing costs in the publishing industry in Australia.

As from the November issue subscription rates will be — Commonwealth, New Zealand, New Guinea, Fiji — 18/- Yearly.

UNITED KINGDOM	£1/-/6
BRITISH EMPIRE	£1/3/-
FOREIGN	£1/5/-

Canberra's Records

MANY Australians have now seen the Canberra jet bomber i action and have appreciated th amazing speed and flexibility of thi new machine. Already the Canberr has broken many airspeed record and does so without attempting t use its maximum speed. Norma flight is well beyond the best performances seen to date in Australi From Laverton to Richmond, a distance of 435 miles, in 47 minute is a sample of what the Canberr can do.

And yet reports are that late designs are not far off which wi make the Canberra obsolete.

The latest de Havilland speedste is the Comet, which flies at 490 mp at 40,000 feet and is planned fo the Sydney-London run in betwee 32 and 36 hours on passenger service.

But a new, un-named aircraft i expected to completely overshado even the Comet. In appearance will look far more like a supersoni fighter than an airliner, having thi swept-back wings, long spiked nos and arrow-head shape.

It's built that way because of th high speeds it will reach in servic

It is expected to cover the Sydney London trip in 20 hours, with a little as three hours on the groun

Height is the keynote to plane like these. Jets need to fly at height above 40,000ft for their engines t be economical.

In the thicker, lower air the fue consumption is prohibitive. As a instance of the fuel factor, the Come weighs in all 105,000lb, of whic 54,000lb is fuel.

It takes power and time to ge to heights like 40,000 and 60,00 feet, and more time to get back agai

POPULAR SCIENCE QUIZ

Q. What results have been achieved to date in research on improved metals for jet and turbine aero engines?

A. For use at such high temperatures, molybdenum metal of high purity has been found to be the strongest material. It also has long life. Recent research has shown that sintered wrought molybdenum at temperatures in excess of 1800 degrees Fahrenheit outclasses other materials, such as titanium carbide and inconel X alloy.

Even at higher temperatures, such as 2400 degrees F., molybdenum has high strength. Tensile strengths of 33,670lb per square inch at 1800 degrees to 27,500lb per square inch at 2400 degrees have been reported. The way the material is worked and handled in manufacture has much to do with the strength of the finished metal.

Molybdenum is a metal that promises to have great importance. It is already used widely as an alloying element in steel and for making electronic equipment. As yet there has been little experience in fabricating large pieces of the pure metal, such as would be required if molybdenum were used as a material for jet engines.

Molybdenum is one of the chemical elements, number 42 in the periodic table of the elements. It melts at 4750 degrees Fahrenheit, almost 2000 degrees above the melting point of iron. The United States has a good supply of this material, since 90 pc of the world's production in the past 25 years has been met from within the North American continent.

Q. Does ultrasonic noise cause any noticeable effect upon the human body?

A. Recent investigations have assisted in forming conclusions that the high frequency noise of the exhaust of turbo-jet engines does not cause nausea, weakness, irritable disposition or other vague ills. In general, noise beyond the range of hearing will not hurt unless the intensity of the sound is sufficient to cook a small animal by the heat generated in its fur. The vague symptoms which may be felt on exposure to the turbo-jet noises are actually due to the very intense middle and low frequency noise that is also present.

It has been found that steady or expected noises do not interfere with work to any significant extent. In fact, some evidence suggests that noise may "insulate" a person from intermittent distraction so that, on some tasks, such as aiming a gun, performance is better in noise than in quiet.

The explanation for this is in the ability of the individual to adapt or "get used to" a steady noise. It could almost be termed the "AVC effect" of the ears.

Q. What is a "caisson?"

A. In general, the term refers to a watertight metal casing used for under-water working, such as laying foundations of bridges. It is somewhat like a large metal cover, open at the bottom. When placed in position, compressed air is fed into the top to force the water out from into the structure, thus allowing construction work to be carried out below the water level.

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Superspeed

Activated
ROSIN CORED SOLDER

Equilibrium diagram of the tin-lead alloys

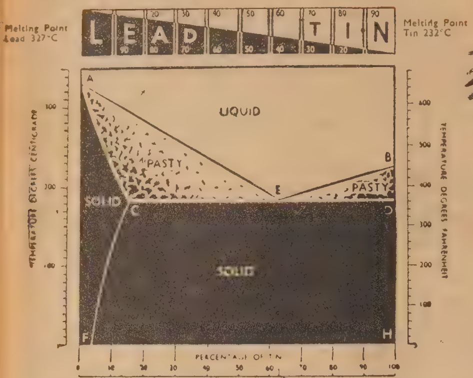
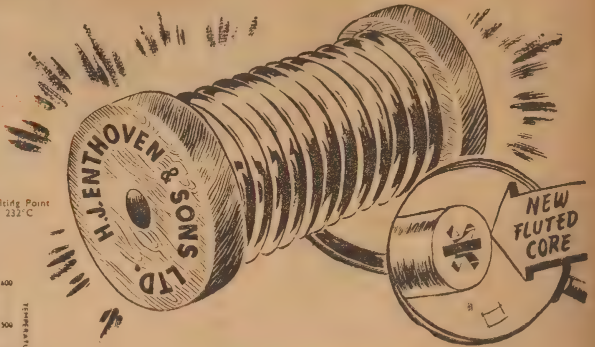


Diagram by courtesy of the International Tin Research and Development

EUTECTIC COMPOSITION TIN 63% LEAD 37%

Approx. Melting Point 183°C.

Complies with M.A.P. Specifications D.T.O. 599 & G.P.O. Spec. M44/c.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2. Increased fluidity accelerates production.
3. Allows more moderate soldering-iron bit temperatures and minimises the risk of physical damage and alteration to the electrical values of small pre-calibrated components.
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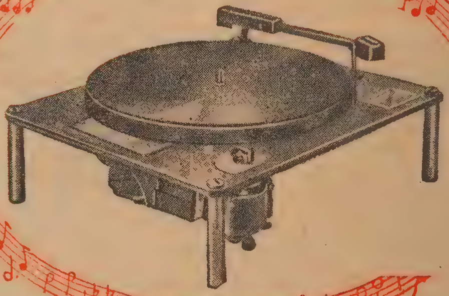
At the turn of a switch you have two speeds, 33⅓ or 78 r.p.m. The Turntable is a full 12" diameter; its main spindle precision ground and lapped, runs in phosphor bronze bearings. The synchronous motor is virtually vibrationless and is suitable for playing standard, transcription and microgroove recordings. Guaranteed mechanically perfect. New super lightweight pick-up available with the interchangeable heads for microgroove and standard recordings.



A Connoisseur (REG) PRODUCT

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so jets look like being unsuitable for really short hops if they are to pay.

1000 MPH PLANES

Jets within not many years may be travelling on the big routes about the world at 1000 mph, bringing any capital within a meal's distance of another.

Director of the American Institute of Aeronautical Sciences said not long ago that America had the know-how to build planes that would certainly fly at 1000-1500 mph.

The British Minister of Supply told the Commons that Britain was developing planes that would fly "at speeds and heights undreamed of."

Toy Makes Good

A TOY which has amused many managing directors in their less busy moments has now been found a practical use in industry.

This particular toy is the one where a piece of metal-coated plastic is made to suspend itself in the air and to resist efforts to push it earthwards. The principle behind it is very simple: in magnetism, positive electricity repels positive electricity. The metal stand below the suspended object was positively magnetised, so was the piece that floated, therefore it continued to float.

This baby HMV television set is claimed to be absolutely the smallest shown in the recent British Radio Exhibition at Earl's Court. It has a 1in tube but is probably not for sale.

Developing this principle, a magnetic device has been designed which causes the top sheet of metal in a stack to float in the air above the rest of the pile. The idea works only with thin sheets of steel, but it is of great value in factories where such sheets are handled, because the workers in the factory can easily pick up the top sheet as it floats.

Helping manufacturers of hearing aids is a new featherweight battery which weighs only half an ounce (0.017 grams). Manufacturers have been striving for long to reduce the weight of components in hearing aids so that the whole set may be as small and light as possible. This enables the user to wear the aid all day without fatigue and also without attracting public attention to it.

*Important NEWS

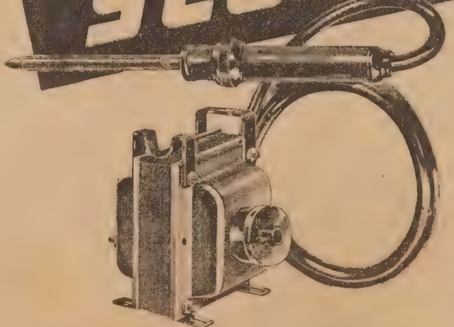
for all
Radio & Electrical Mechanics
Instrument Workers
and all who use
a Soldering Iron

At last soldering has been looked at by scientific eyes. The object? To eliminate time wasted while the iron heats-up, consumption of current while the iron is not in use, danger of human or mechanical damage from parts of the iron not immediately connected with the soldering tip, and to provide safe, low voltage operation from A.C., D.C. or battery operation, or from A.C. mains with transformer.

The result is the now famous Scope Soldering Iron. It heats-up in six seconds, operates from 2.5/6.3 volts A.C./D.C. or from any mains supply with a suitable transformer. It consumes no current when not in use and operates instantly with a light thumb pressure on the switch ring. Beautifully balanced and almost feather-light, there is little chance of burning work or parts of the body as all heat is generated at the soldering tip.

Ask for a demonstration of this really remarkable soldering iron to-day at your local electrical dealer or supplier. Only a demonstration will convince you of Scope's extraordinary efficiency which is equal to that of *other irons rated up to 150 watts.*

SCOPE



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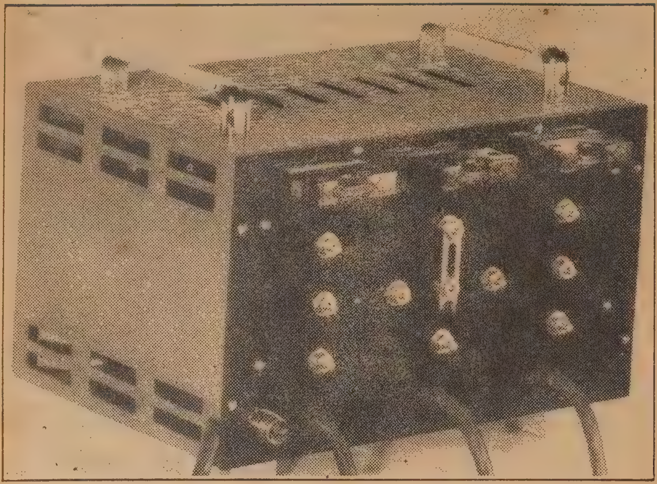
MANUFACTURED BY SCOPE LABORATORIES, MELBOURNE, VICTORIA

S.21.HP

A HEAVY DUTY CHARGER UNIT

A maximum charge rate of 9 amperes to one accumulator or a 3 ampere charge rate to six accumulators—these are the main features of our new battery charger. Patterned after the charger previously described, this new job takes over where the smaller version leaves off. It should prove of great advantage to small garage owners and cab group operators.

by Raymond Howe



Here is the charger fitted into its case. The switching link is shown on the centre channel only. The two outside channels require a similar link. The "up" position is for 6 volts, the "down" for 12 volts. On the centre channel, to the left is for 2 volts, to the right for 4 volts.

AT the present time, battery chargers larger than the home-garage size are at a premium. Shortage of vital components has set delivery dates of commercial units back many months, in some cases approaching almost a year.

And that is not all. The purchase price of a big charger is quite steep these days, running to best part of three figures for the more elaborate varieties. Much of the cost is bound up in the special heavy duty metal rectifiers needed for the job which, however, are far more expensive, watt for watt, than the smaller and mass produced rectifiers.

REASONABLE COST

We reckoned that, by using these smaller and more familiar components, it would be possible to produce a more ambitious charger for quite a reasonable outlay. The nett result is a unit which is capable of a 9 ampere charge rate to a 6 or 12-volt accumulator or a 3-ampere charge rate to six 6-volt or three 12-volt accumulators. Intermediate charge rates are available, such as 6 amperes to a 6 or 12-volt accumulator plus 3 amperes to an additional 6 or 12-volt accumulator.

Another feature is that one of the output channels can provide a 3-ampere charge rate to a 2 volt or 4-volt accumulator without affecting the operation of the other two channels.

It can be seen then that this new charger fills a gap and for a very moderate outlay. The hand-made switching link on the front panel for each output channel may not be quite as convenient as the knob-controlled rotating switches found on commercial chargers but the effect is the same.

The provision of three separate and quite independent output channels is an important point. It gives flexibility in the handling of the unit. Alterations to the load on one channel does not affect the operation of the other channels. No balancing of circuits is necessary.

The independent channels are obtained by using three separate rectifier units, each with its own ballast or limiting resistor and fuse and fed from individual secondary windings on the transformer for which there is a common primary winding.

Each secondary winding provides an output voltage of 17 volts and 11.5 volts, these voltages being suitable, with the rectifier type used, to charge a 12 volt and a 6-volt size of accumulator respectively at a maximum rate of 3 amperes. One secondary winding, supplying the centre output channel in the photograph, has additional tappings at 10 volts and 8.5 volts to handle the 4 volt and 2 volt size of accumulator respectively at a 3 ampere charge rate.

The selection of the correct tapping on the secondary windings is simply a matter of rotating the switching link on the front panel to the required position as marked, slipping it under the nut and tightening it "finger-tight."

SEPARATE FUSES

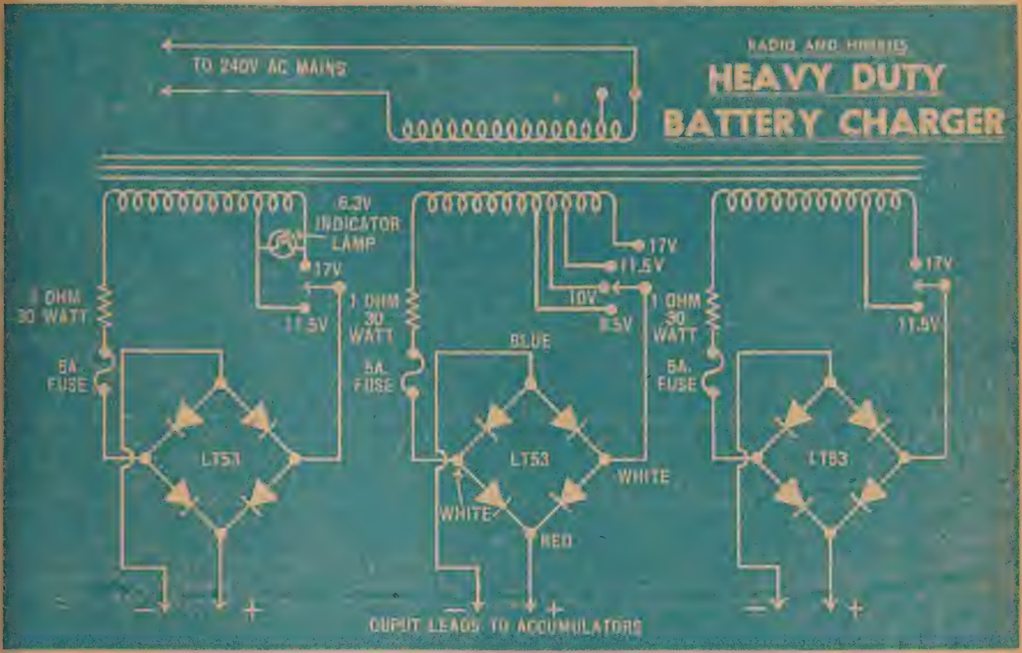
Once this simple setting has been made, the unit can be left alone until the accumulators have been charged because it is self-regulating and self-protecting. The output voltage for each setting adjusts itself to suit the condition of the accumulator, being reduced when the accumualtor is low in charge and increased proportionally as the terminal voltage of the accumulator rises with charge.

Each channel is separately fused so that if the clips on the outgoing cable are accidentally short-circuited or, if for any other reason, an excessive output current flows, the transformer, and particularly the rectifier, is protected from damage. These fuses are rated at 5 amperes and, if at any time they are replaced, it is most important to do so with fuse wire rated to "blow" at 5 amperes. The obvious idea is to have a card of 5 ampere fuse wire hanging near the unit.

For a 9 ampere charge rate, the output leads from each channel are paralleled across the 6 or 12-volt accumulator to be charged and the switching links of each channel set to 6 or 12-volt positions as the case may be. The only point to watch is that the leads from each channel are connected in the correct polarity, that is, all positive leads clipped together and to the positive terminal of the accumulator and all negative clips to the negative terminal.

CAPACITY

Because each channel can deliver 3 amperes, two channels can be paralleled to give a 6 ampere charge rate whilst the remaining channel can be used to deliver 3 amperes to another set of cells. The most suitable combination can be arrived at quite simply by considering that each channel can charge "12 volts of accumulator" at 3 amperes, whether the "12 volts" is represented by one



This circuit diagram illustrates the general simplicity of the wiring of the charger. The colour code for the leads from the transformer is supplied by the manufacturers. The centre bolt carrying the link on the front panel is illustrated in this diagram by the arrow "sweeping" the transformer tappings.

12-volt accumulator or two 6-volt accumulators connected in series.

Two accumulators are said to be connected "in series" when the positive terminal of one is connected to the negative terminal of the other, the remaining positive and negative terminals then being considered as the terminals of a composite accumulator of twice the voltage. For parallel connection, the positive terminals of the accumulators are connected together and likewise the negative terminals. The voltage remains unchanged but the charge is divided between the accumulators.

It can be seen then that if two 12-volt accumulators are connected in parallel and attached to one channel, set for 12 volts, the available 3-ampere charge will divide between the two accumulators according to their condition. If they are in a similar state of discharge, each will receive approximately 1½ amperes. This same condition could exist for four 6-volt accumulators connected in series-parallel although, under normal circumstances, the more usual series arrangement is suggested mainly because the condition of one or more accumulators does not then affect the charge into the other or others.

SIMPLE CONSTRUCTION

There is not a great deal in the construction of the charger particularly if the chassis and case are purchased ready-made. You will need to make up the front panel yourself. It's merely a matter of cutting the material to size and drilling the holes to provide a symmetrical layout. The panel measures 10¾in by 6¾in. We used bakelite, although masonite or plywood treated against moisture absorption would do just as well. The bakelite will need to be from 1-8in to 3-16in thick.

The chassis measures 9¾in by 6½in by 1¼in deep with the folds at the front and rear, the sides being open to improve the ventilation. The side brackets which hold the front panel are part of the chassis material, although they can be attached separately if desired. These brackets extend beyond the front of the chassis so that the front panel will be 1 1-8in from it.

The 1½in by ½in slots in the chassis in various places provide ventilation for the components. These points are under each rectifier, near the ballast resistors and underneath the transformer winding on each side of the core. Two more slots are located on the rear face of the chassis below the centre rectifier so that this rectifier will receive as much cooling as the outside ones.

The case measures 10¾in by 6¾in high by 7 7-8in deep with a 3-8in fold to make a front lip on the top and sides. You can get some idea from the photograph of the steps taken to provide good ventilation. The pattern in the sides and in the top is clearly visible. These slots measure 1¾in by 3-8in. The pattern in the rear face consists of four slots centrally placed top and bottom, the same size as on the sides and the same position relative to the top and bottom edges.

The underside carries eight slots 1¾in by ¾in in two rows of four each and running the same way as those in the top. The rows are ¾in apart and are ¾in from the rear edge.

A pair of chromium-plated handles on the top and a pair of 1in by 1in timber feet complete the picture. The accentuated feet are, again, in the interests of ventilation.

The rear top view of the innards

PARTS LIST

- 1 case 10¾in by 6¾in by 7⅞in deep, with ⅜in lip at front edge.
- 1 chassis 9¾in by 6½in by 1¼in deep, open ends, with side brackets extending 1⅛in beyond chassis front.
- 1 bakelite panel 10¾in by 6¾in by ⅛in or 3/16in thick.
- 1 charger transformer with two 4 amp secondary windings of 17V, tapped 11.5V, one 4 amp winding of 17V, tapped 11.5V, 10V and 8.5V.
- 3 LT53 dry rectifiers (bridge type).
- 3 1 ohm 30 watt resistors, vertical mounting.
- 1 indicator light holder and 6.3V lamp.
- 3 fuse holders, 5 amp.

SUNDRIES

6 to 7 yards of 3-core 23/.0076 rubber covered cable, 1 6-tag mounting strip, 1 3-pin power plug, 6 25 amp battery clips (3 positive, 3 plain), 2 handles for case, 1½ doz ¾in by 3/16in brass bolts, 3 doz. 3/16in brass nuts, 3 doz. 3/16in brass or steel flat washers, 1 doz. ⅜in by ⅛in brass bolts with nuts, scrap material for switching link and cable clamps.

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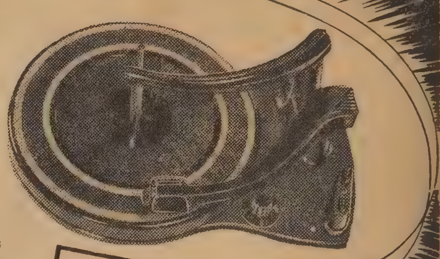
Other features include: A set pick-up pressure of 11 grams approx.; Simplified controls; Rigid die-cast base; Robust bakelite pick-up arm with modern smooth outline; Free instruction booklet.



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At 78 r.p.m. 10" and 12" Records can be mixed.
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At 45 r.p.m., 7" Records can be played.
Up to 10 Records can be played in one cycle.

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of the charger shows fairly clearly what goes where. We suggest that, to start with, you leave the front panel for the time being and concentrate on getting all the components mounted into place on the chassis. See that the rectifiers are spaced as far apart as possible without protruding over the edge of the side bracket.

We used 3-16in diameter bolts to secure the transformer, which is a fairly heavy component. Use a nut as a spacer on each of the bolts to hold the transformer above the chassis for approximately 1-8in to give a little more clearance for the leads to the front panel. The light gauge connections to the primary winding and the electrostatic shield are passed through one of the ventilation slots below the transformer and soldered on to an insulating tag-mounting strip where connection is made to the cable which connects to the power mains. Make sure that no leads are pinched between the transformer and chassis.

With the chassis-mounting components ready for wiring, prepare the front panel for attachment to the chassis, slipping into place the indicator light holder, the fuse holders and switching link bolts, complete with two nuts and requisite number of washers.

Sort out the heavy gauge secondary leads ready for trimming and connection to the front panel, making doubly sure that you are mating the correct ones as indicated by the color code supplied with the transformer. You may find it necessary to use a multimeter for this purpose or, alternatively, a torch battery and torch globe.

SWITCHING LINK

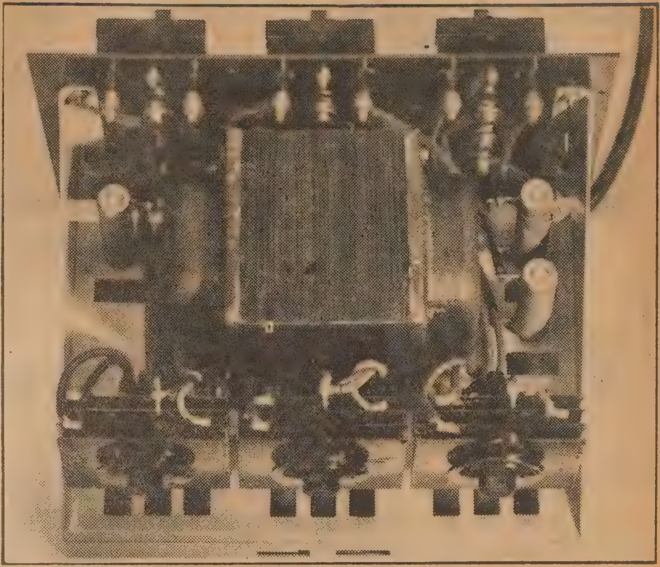
In the front view photograph, you will see the bolts associated with the switching link of each channel. Each has a centre bolt to carry the switching link plus an upper and lower bolt, the upper being for the 6-volt position and the lower for the 12-volt. On the centre channel, two additional bolts are placed on either side of the centre bolt, the one on the left representing the 2-volt position and that on the right the 4-volt position.

Bend the leads upwards so that they will lie against or close to the front panel and lay the panel in place. Commencing with the leads which connect to the lower bolts, note how long they will need to be to make easy connection and cut them to length. Carefully cut away the insulating sleeving, bare the enamelled wire and "tin" the ends with the iron.

Treat each wire in this manner, bending the tinned end into a form of goose-neck ready for slipping between the two washers on the front panel bolts. In the case of the leads for the lower voltage tappings, where there will be two enamelled wires in the one insulating sleeving, scrape the enamel off, twist the ends together and "sweat" them together. These "twin" wires for each tappings must be joined together to maintain continuity in the winding.

With the leads from the transformer secondaries securely attached to their respective bolts, the front panel can be left supported by these leads while the remainder of the wiring is completed.

TOP VIEW OF THE CHARGER UNIT



The position of all components and the location of the ventilation slots can be seen in this view. Make sure that the rectifier cooling fins do not touch under any conditions.

Naturally, the wire used should be heavy enough for the job. House wiring cable of the 3/.029 size is satisfactory and easy to handle or, alternatively, one of the cores from the 3-core cab-type cable, required for the mains lead and the leads from each channel to the accumulators, would do.

3-CORE CABLE

It is essential in the interests of safety as well as to conform with regulations, that the mains lead be of the 3-core type. The red and black cores will connect the transformer primary to the power mains while the green core is used to connect the chassis of the charger to the earth wiring of the power mains outlet socket.

This cable may just as well be the same size as that used to connect to the accumulators. We used the 5 ampere rated cable which is of 3-core, each core being of 23/.0076 size, that is 23 strands of .0076 size tinned copper wire.

For the connection to the accumulators, we connected the black and green cores together to form one lead, the red core forming the other lead. At the free end of each channel cable, a pair of 25 ampere size accumulator clips are attached. Cut one lead shorter than the other so that when the clips are attached and let hang, they will not "short-circuit" together. The length of cable for each channel is a matter of individual requirement. About 5 feet should be sufficient in most cases.

We could have used terminals on the front panel to take leads to the accumulators but, in this case, we preferred the continuous length of cable running from the inside of the charger to the accumulator. Apart from the fact that suitable terminals are not readily available, it is usually found that once the length of cable has been decided upon, it stays that way.

BATTERY CLIPS

When a channel is idle, its cable can be doubled back on itself and the clips "gripped" onto the cable.

Inside the changer, channel cables are held to the chassis by a clamp fitted on the bolt which holds each rectifier. Beyond the clamp, the outer rubber covering is stripped off and the three cores are passed through a rubber-grommeted hole up to the top of each rectifier for connection to the lugs colored red and black. As with the clips at the other end, use the red core for the connection to the positive lug (red) and the black and green cores connected together for the negative lug (black).

The switching links can be fabricated from brass plate, making it just on ½-inch wide and 2-inches long. The slot along the centre allows the link to be slipped up or down, left or right, without having to be rotated more than a quarter turn. For a spacing of 1¼in centres from any bolt to the centre one, the measurement of 2 inches is such that the link cannot connect more than one bolt to the centre bolt at the one time.

The front panel is secured to the case by drilling and tapping the 3-8 inch fold on the case to take 1-8 inch bolts.

In the initial trial, it would be handy to have a 5 ampere-range meter to check the functioning of each channel. Failing this, a double check on the wiring as well as a check for overheating during operation would probably suffice.

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Power Supply Design

Power supplies appear so elementary on the surface but they nevertheless present many puzzling features for the beginner. Here are a few random observations to think about.

A POINT which puzzles many beginners is how a power supply can deliver a DC output voltage which is substantially higher than the RMS rating of the power transformer secondary. How can a set have 250 volts DC on the HT line, for example, when the transformer rating is only 250 volts to begin with and there is perhaps 20 volts lost across the filter?

The answer lies in the fact that most ordinary receiver and amplifier supplies operate with a condenser input filter system—in other words, the first filter component immediately after the rectifier is a large filter condenser. This may commonly have a capacitance of anywhere between 4 and 16 mfd.

TO PEAK VALUE

In operation, the input filter condenser tends to charge to the peak value of the AC input voltage, which is just over 1.4 times the rated or RMS value. This means that a 250-volt transformer can charge the first filter condenser to a peak value of nearly 350 volts. In fact, the figure would be measurable on a voltmeter under conditions where there was little drain on the supply.

When there is a substantial drain on the supply, the measurable voltage across the first filter condenser is reduced, the DC input to the filter approximating the AC input to the rectifier in the region where the load current is between about one third and two-thirds the rated maximum load for the particular rectifier.

For still heavier figures of load current, the DC output across the first filter condenser will usually lie somewhat below the AC input voltage.

This large variation in DC output voltage with load current simply means that a condenser input filter system shows much poorer "regulation" than where the alternative choke input filter is used. However, regulation is seldom important in ordinary receivers and amplifiers, where the load current seldom varies under any circumstances by more than a few per cent.

As the term implies, a choke input filter is one where the filter choke immediately follows the rectifier, the condenser being on the output end of the network.

LOWER OUTPUT

With a choke input filter, the maximum measurable DC voltage, even without a substantial load, does not rise normally above 0.9 times the AC input. It decreases gradually with increasing load down to possibly 0.75 times the AC input at full load with typical components. Thus the DC output with a choke input filter is always less than the AC input but it does not vary as widely with applied load as when a condenser input filter is used.

This good regulation characteristic is important in class B amplifiers &c., but not in ordinary equipment.

The omission of the first filter condenser makes for a much higher ripple content in the output of a filter system so that, all other things being equal, a choke-input filter needs to be more complicated or more costly than a condenser input filter for the same degree of smoothing. The transformer voltage rating needs to be higher also for a given DC output voltage.

The figures in both cases refer to the DC available at the input to the filter system. From this must normally be subtracted the drop across the filter choke (or chokes).

CURRENT RATING

Ordinary receiver and amplifier power transformers are normally rated in terms of so many milliamps load on the assumption that condenser input filter will be used. If a choke input filter is used instead, the permissible load current can be increased by approximately 20 pc.

Reason for this is that the heating effect in the transformer is measured basically by the total output load in watts. Where the nature of the filter reduces the fundamental output voltage, the current can be increased proportionately for the same load wattage.

It is not always appreciated that the smoothing action of a filter is governed by the order of the load current. A heavy load tends to discharge the filter condensers more completely between the charging cycles, while the inductance of the choke is also likely to be reduced with heavier drain.

EFFECT OF DRAIN

The effect is quite noticeable with some class B or class AB2 amplifiers. An oscillograph test may reveal very little ripple under quiescent conditions, the ripple reaching quite substantial proportions under full power and with a heavy drain on the supply and filter components.

Taking things in the opposite direction, a very simple filter system can be used effectively where the load current is small.

Best example of this is the decoupling circuit for a voltage amplifier, which may use say a 50,000 ohm resistor and an 8 mfd. condenser. If the current is a milliamp or less, the drop across the resistor will not exceed 50 volts, while the residual ripple across the condenser will be very small. It is often possible to operate a decoupling network of this type directly from the rectifier filament for reasons of stability and still have adequate filtering at the amplifier plate.

In the village of Itabira, Brazil, there are streets paved with iron. One company is planning to mine 1,500,000 tons of ore annually at Itabira. Brazil is also rich in gold; in the mine at Morro Velho some 12-million tons of gold ore have been mined. In yet another district diamonds are mined; most valuable discovery so far was the world-famous President Vargas gem, discovered in 1938, which weighed 726.6 carats.

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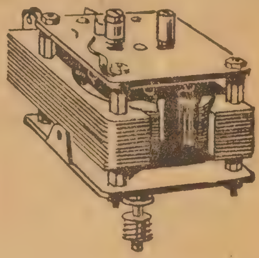

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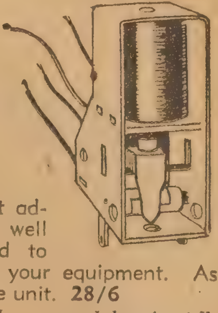

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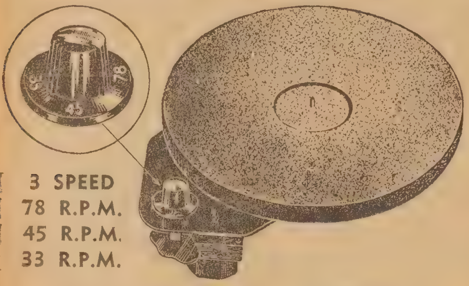

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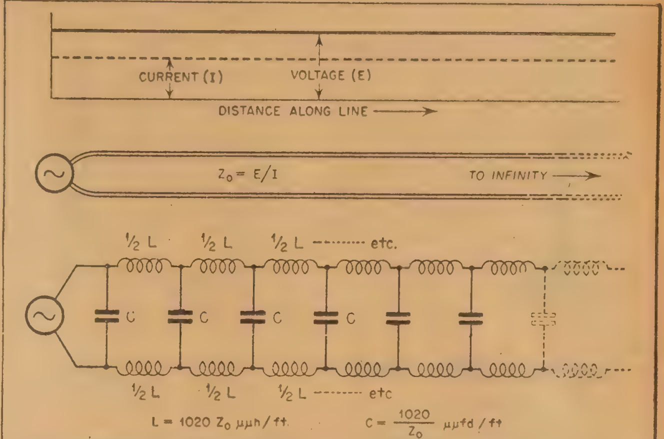
THEORY OF TRANSMISSION LINES

This special article contributed by Aerovox Engineers provides an excellent survey of the subject. With the increasing utilisation of the high-frequency portion of the radio frequency spectrum, transmission lines are assuming greater importance for both the transmission of energy and as circuit elements.

SPECIAL transmission line sections are used extensively as resonant circuits in place of lumped-constant, coil-and-condenser circuits in many VHF and UHF applications.

The cavity and waveguide circuits used at microwave frequencies can also be shown to be evolved from the types of transmission lines employed at lower frequencies and are subject to similar laws.

In the past, a thorough knowledge of transmission line theory was used to great advantage only by those engaged in antenna or transmission line work. Now, however, with coaxial and open-wire line sections being used as circuit elements in the transmitters and receivers themselves, a basic understanding of their functioning is required of every worker in the field, and merits frequent review.



INFINITE TRANSMISSION LINE AND LUMPED EQUIVALENT

FIG. 1

TRANSMISSION LINES

A transmission line is an electrical system, usually consisting of two metallic conductors, which is used to transfer electromagnetic energy from one point to another.

Any line of this type, whether it be coaxial, open-wire, waveguide, or any of the other possible configurations, is characterised by an attenuation constant, a velocity factor, and a characteristic or "surge" impedance.

These properties are determined by the geometry of the conductors forming the system, the materials of which they are made, and the dielectric material used as insulation between them.

Losses in rf transmission line are of three types; heat losses in the metallic conductors, losses in the dielectric material surrounding the conductors, and losses occasioned by radiation of energy from the line into surrounding space. The latter losses are of importance only in unshielded types of lines.

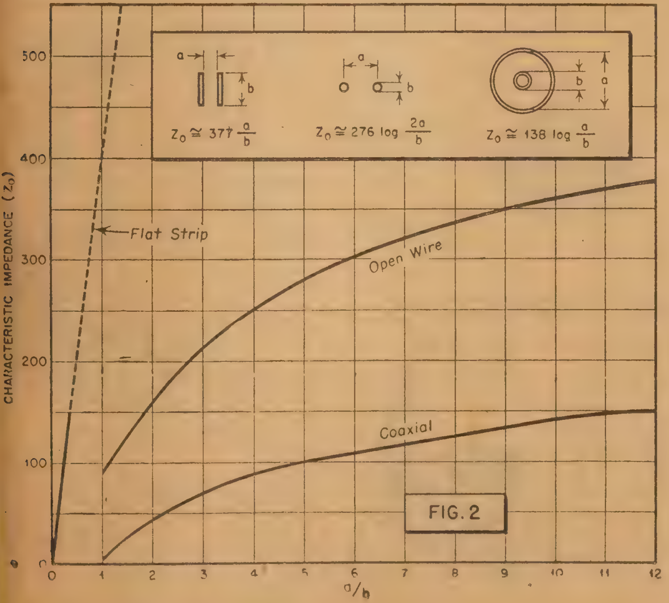


FIG. 2

Although the attenuation constant is most properly expressed in nepers per unit length, decibels per unit length is more frequently used in practice. These units are obtained by multiplying the attenuation constant in nepers by 8.69.

The velocity factor of a transmission line is defined as the ratio of the velocity of an electromagnetic wave travelling in free space.

This characteristic is controlled principally by the dielectric constant of the material used between the line conductors. It is unity for common lines having air dielectric, since waves on such lines travel with the speed of light as they do in free space.

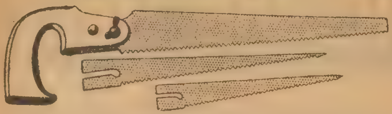
VELOCITY FACTORS

Lines having solid dielectric material between the conductors have velocity factors less than unity. As an example, the velocity constant of 300 ohm television twin-lead is about .82.

The velocity factor is of importance since it defines the length of waves on the transmission line and must be considered when cutting resonant sections for antennas, matching sections, or other purposes.

In the example mentioned above, the wavelength on the line is 82 pc of the length of a wave of the same frequency in free space. In other words:

BARGAINS FOR THE HANDYMAN



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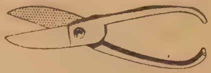

Special price for both Saw and Tin Snips, **19/6** posted.

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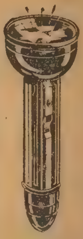
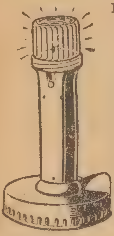


All Chrome finish 2 cell, 3" reflector spotlight, Super-torch, **23/9** complete (25/- posted) Also available in 3 cell type at 29/2, 32/- posted. 5 cell model 46/9 posted.

PLASTIC CANDLESTICK



Battery operated coloured plastic candle stick torch fitted with standard 2.5 volt torch bulb and standard No. 8 battery (or 2—927 cells). Height 5¾" x 3⅝", with switch located on stem. Spare batteries 1/-, globes 7d each. Ideal as an emergency table lamp or nursery light. Absolutely safe and reliable, 11/6 posted, complete.

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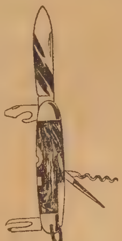

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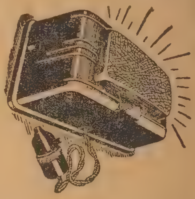

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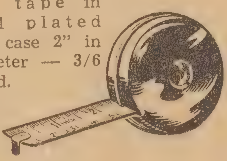

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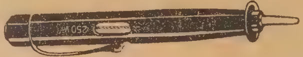

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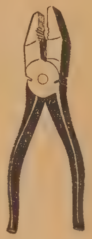

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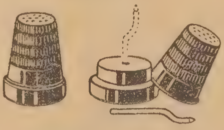
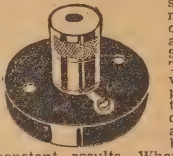
Special Midget **TORCH** with No. 8 Battery, **4/6 posted.**

THE NEW "RED SPOT" SAPPHIRIN TIPPED PHONO NEEDLE



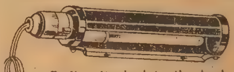
Plays over 1000 standard records. Packed in an attractive jewel case for safekeeping. Ideal for radiograms and automatic record players. 17/6 posted.

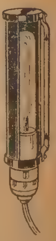
New Invention Crystal Detector



The "Red Spot' highly sensitive semi-fixed permanent crystal detector is now available for 9/6, 10/- posted. The "Red Spot" will take the place of the old type crystal and cats - whisker and give much better and more constant results. When necessary, it is easily adjusted by means of the knurled cap as illustrated.

Unbreakable Bed Lamp

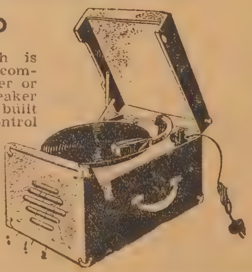




Easily attached to the bed with screws supplied; all metal, rustproof; beautifully finished in polished chrome plating; measures 7½" x 2" in diameter; with plastic push bar switch-holder, movable shade allowing the light to be thrown in any direction. Will last a lifetime. Can be attached either vertically or horizontally. Price complete with globe and 9 feet flex—45/-, 48/- posted.

PORTABLE ELECTRIC PHONOGRAPH

240 VOLTS A.C. MAINS OPERATED



This self-contained portable electric phonograph is housed in a leatherette covered carrying case and is complete ready to operate from any 240 volt A.C. power or light socket. It has an amplifier with 8-inch speaker and electric phonograph motor and crystal pick-up built into the cabinet. It is equipped with a volume control and on-off switch. Supplied ready for use with two yards of power lead at £19/17/6, freight and packing £20/17/6, C.O.D. Rail, £21/7/6 (N.S.W. Only)

Interstate cash with order only £20/17/6.

Immediate delivery available.

ORDER NOW.

RADIO HOUSE PTY. LTD.,

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Sydney

(1) $$\text{VELOCITY FACTOR } (\beta) = \frac{v}{c} = \frac{\lambda'}{\lambda}$$

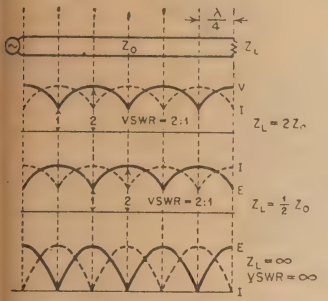
Where:

v is the velocity of a wave on the line
c " " " " " " in space.
λ' is the length of a wave on the line
λ " " " " " " in space.

The concepts of characteristic impedance and impedance matching are probably the most important in the use of transmission lines. These ideas are universally employed to insure maximum transfer of energy from one point to another by means of transmission lines.

The characteristic impedance of a transmission line may be defined as the ratio of voltage to current on the line if it is infinitely long or is otherwise arranged so that waves travel on one direction only.

Under this condition, current and voltage distribution is uniform with distance along the line and it is said to be "flat."



EFFECT OF TRANSMISSION LINE TERMINATION ON S.W.R.
FIG 3

Fig. 1 shows a distribution of this kind on a hypothetical infinite line. The lumped-constant equivalent of the line is also shown.

The coils represent the inductance of the conductors and the capacitances are formed by the proximity of the conductors to each other. If the inductance and capacitance values per unit length of the line are known, the characteristic impedance is expressed approximately as:

(2) $$Z_0 = \sqrt{\frac{L}{C}} \text{ ohms}$$

In Fig. 2 the characteristic impedance of several commonly used types of air-insulated transmission lines are plotted.

Infinitely long transmission lines are, of course, only possible in theory. In practice, other means must be employed to prevent waves from being reflected from the far end of the line and causing standing waves, with attendant loss of efficiency.

This is usually accomplished by terminating the line with a load impedance which is a pure resistance equal to its characteristic impedance. Under these conditions, all energy reaching the load will be absorbed and no reflections will result. Voltage and current are then uniformly distributed along the line as in Fig. 1, and the line is said to be "matched."

If the transmission line is not terminated in a resistive load impedance equal to its characteristic impedance (Zo), reflections will occur from the load end due to unabsorbed energy travelling backward toward the generator.

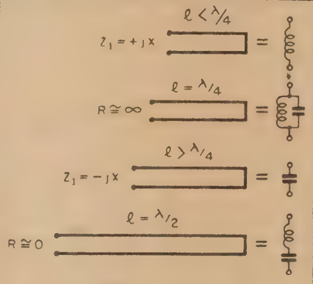
These reflected waves are out of phase with the incident waves at some points and in phase with them at others so that the oppositely travelling waves alternately add or subtract. The result is a system of stationary standing waves.

Fig. 3 shows the standing wave and phase conditions for lines terminated in various manners. The amplitude of the voltage standing wave pattern is proportional to the ratio of the terminating resistance to the characteristic impedance of the line, or vice versa, whichever is greater than unity.

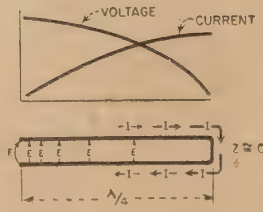
Thus a 300 ohm line terminated by either a 100 ohm or a 900 ohm resistive load will show a voltage standing wave ratio (VSWR) of 3.1. In a similar manner, a length of transmission line shorted at the end will exhibit the same (theoretically infinite) VSWR as one left open circuited at the load end.

The standing wave ratio thus serves as a convenient measure of the degree of match existing between the line and its load. The percentage of power lost due to reflections from a mis-matched load, plotted versus VSWR, is given in Fig. 4.

Special transmission line sections are used for resonant circuits, impedance transformers, filters and rf chokes in high frequency and micro-wave practice. At least a qualitative understanding of the properties of such line sections is necessary for a grasp of modern rf circuitry.



CHARACTERISTICS OF SHORTED LINE SECTIONS
FIG. 5



VOLTAGE AND CURRENT ON 1/4 WAVE LINE
FIG 6

Most of the special applications of short sections of transmission lines are based on the properties of a uniform line shorted at the load end. The input impedance (Zi) of such a line, if losses are neglected, is expressed as:—.

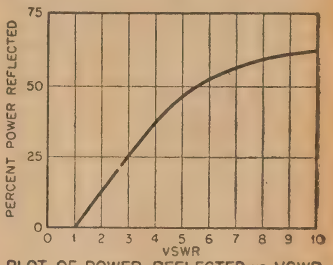
(3) $$Z_1 = Z_0 \tan 2\pi \frac{\ell}{\lambda}$$

Where:

Z_0 is the line impedance.
ℓ is the line length in cm.
λ is the operating wavelength in cm.
2π is 6.28 radians or 360 degrees.

An inspection of this equation indicates that the input impedance of the shorted line section varies as the tangent of its electrical length in radians and is infinite for a line of one-quarter wavelength or odd multiples of quarter-wavelengths long. In practical cases, when losses are present, the input impedance is not infinite but is very high and is a pure resistance.

For sections which are even multiples of quarter-wavelengths long, the input impedance is very low (theoretically zero) and is also resistive. Thus, a quarter-wavelength section is equivalent to a parallel resonant circuit at its input terminals, while a half-wavelength section shorted at the end has the characteristics of a series resonant circuit.



PLOT OF POWER REFLECTED vs. VSWR
FIG. 4

Intermediate lengths are reactive and have the properties of coils and condensers. These comparisons are illustrated in Fig. 5.

By far the most important transmission line "building block" used at VHF and UHF to form circuit elements is the quarter-wave shorted line. It recurs so frequently in so

(Continued on Page 55)

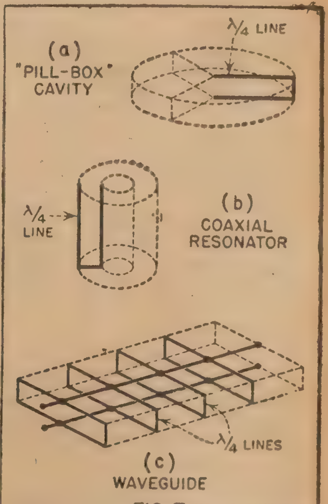


FIG. 7

FITTING AN EXTENSION SPEAKER

By making a small modification to the speaker on an existing set, it is possible to provide a ready outlet, with switching, for an extension speaker. This article describes the procedure for those who are not too sure of their ground.

THE first job is to gain access to the main speaker and, in a console receiver, this will involve nothing more than withdrawing a plug from the chassis and undoing the four screws which normally hold the speaker to the baffle board.

In the case of a mantel set, it may be necessary to remove the chassis from the cabinet, since the speaker and chassis are normally bolted together. If the voice coil connections are then accessible, all will be well but, if they cannot be reached without in turn taking the speaker off the chassis, you had better take stock of the position.

If the job looks like being too hard, it may be wiser to decide on the alternative approach, which was described in the September, 1950, issue. This avoids any interference with the set at all, involving a small unit and an adaptor plug and socket which fits underneath the output valve.

CARE WITH CONE

However, provided you can conveniently get at the voice coil connections on the speaker, the method suggested here is somewhat simpler and cheaper. The main point is to keep roving fingers away from the paper cone, which is easily torn but not easily replaced in these days of shortages.

If the speaker is an electrodynamic type, you will find a wiring arrangement similar to that depicted in the accompanying diagram.

The output transformer will normally be mounted on the speaker and two spaghetti-covered wires—about 24 gauge enamel—will come from it to a couple of solder tags just behind the cone.

From the first of these, a flexible lead will normally go straight to an anchor point in the cone. The return wire from the cone comes back to a third solder tag, while another pair of spaghetti-covered wires runs down somewhere inside the field coil housing.

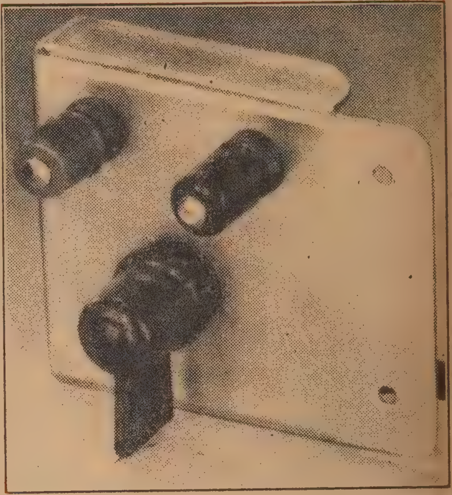
These last-mentioned wires run to the hum-bucking coil, which is invariably used in all electro-dynamic speakers. It is connected in series between the voice coil and the secondary of the output transformer, being so arranged that it cancels out any hum that may be fed into the voice coil by reason of ripple across the field.

HUM BUCKING

The hum-bucking coil is obviously not necessary in a permagnetic speaker and the leads from the output transformer simply run straight to a couple of lugs and thence to the voice coil. If you have a permag. speaker in your set, therefore, just ignore the hum-bucking coil, as shown in our diagram.

Now for the modifications. Locate one secondary lead from the output transformer which joins directly to a lead to the cone and voice coil. Leaving the voice coil lead undisturbed, unsweat and lift off the lead from the output transformer.

This will have to be anchored to another insulated point and an easy way is to use a small two-terminal tag strip. Solder it in position with one lug and use the other as an anchor point for the wire you have just freed. If the lead is too short, it can be extended with a small piece of tinned copper and a scrap of spaghetti.



A suggested bracket for mounting the connections and switch.

The next step is to prepare a 3-wire cable about two feet long which can attach to the speaker. You can plait three different colored wires or, better still, use a length of light 3-core flex, which will normally contain a red, a black and a green lead.

Connect the flex to the three points shown in our diagram—(1) the free lead from the output transformer (2) the free end of the voice coil and (3) the remaining lead from the output transformer, leaving undisturbed any other connection to the same point.

FLEX FIXING

To save dragging any wires adrift, should the flex be strained, it is wise to make up a clip of some description to clamp the flex to the speaker housing. One of the transformer mounting holes is usually the most convenient place for a bolt and clamp. So much for the speaker end of the business.

The next job is to make up a small bracket from a scrap of aluminium. The size is not at all critical but it should be large enough to accommodate a 3-position wafer switch and a couple of terminals.

The one shown in the photograph measured approximately 3" x 3½", with a ½" flange turned down on three sides. Two holes were drilled in the remaining edge to allow the unit to be screwed to the rear of a wooden cabinet.

The accompanying diagram shows the unit wiring in detail. Only two switch poles are requred but most 3-position wafers are of the 3-pol type, leaving one pole unused.

Wired as shown, one side of th transformer secondary circuit i common to both the main and th extension speaker. The other sid is switched to the main speaker only to both speakers or to the extensio only, as required. Outlet to the extension speaker is by a couple of insulated spring terminals.

The extension speaker must be permagnetic type and it should preferably have about the same voic coil impedance as the speake already fitted in the receiver. Thi will ensure a reasonable balance between the sound level from the tw speakers.

If you cannot establish the voic coil impedance of the existin speaker, or cannot obtain an extension speaker to match it, the onl course is to use a standard permagnetic type which will probably hav a coil impedance of about 2 ohms.

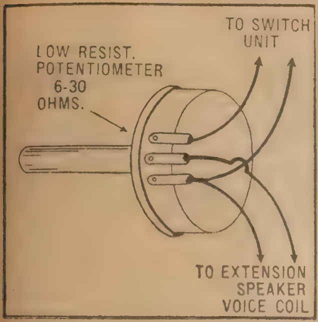
THE SPEAKER

The extension speaker can b bought without transformer or, if transformer is fitted already, should be disconnected from th voice coil. Simply run two leads fro the voice coil lugs and clip the under the terminals of your extension speaker switch unit.

As for the connecting leads, the should ideally have as low DC resistance as possible, since a resistance of even 2 ohms will nominall halve the input to the extensio speaker.

In practice, about the neate solution to the problem is to inve in a few yards of twin plastic lam flex of a color that will merge wit the wall or floor coverings. On the assumption that the extension speaker in an average home will not be more than one room away from the main set, the DC resistance problem is not likely to affect results too seriously.

In the average set, with a 6F6 or a 6V6 in the output, there will be ample power to feed both speakers for normal program listening.


TO SWITCH UNIT
LOW RESIST. POTENTIOMETER 6-30 OHMS.
TO EXTENSION SPEAKER VOICE COIL

A volume control on the extension speaker allows its output to be cut back below that of the main speaker.

Volume with either or one speaker in use should not be greatly affected while the mismatch should not cause any noticeable deterioration in quality at moderate listening levels.

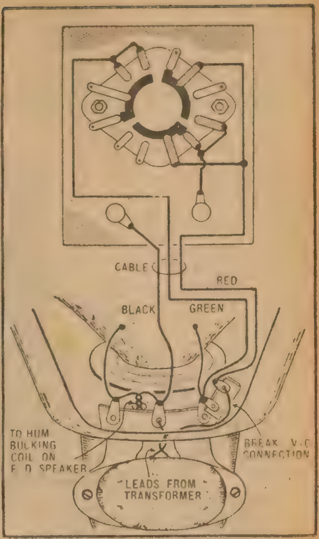
One point is important, however, namely the mounting arrangement of the extension speaker. It needs the best baffling you can arrange in the interests of bass response.

An eight-inch speaker is probably the best all-round proposition for the extension unit, representing a good compromise between quality and compactness. Five-inch speakers are really too small for good quality, while three-inch speakers cannot be expected to stand up to continuous heavy use, quite apart from their tonal limitations.

A seven or eight-inch speaker might well be mounted in a wall box, approximately 12 inches square by seven inches deep. If mounted high up, the face can be inclined downwards to good effect. Line the inside of the box with paper felt and cut a couple of small vent strips along the bottom of the box to relieve internal air-pressure.

A speaker box of this general type will give much the same baffling as an ordinary mantel type cabinet.

Where space is no object, a 12-inch speaker could well be used for the extension with as elaborate a baffle as you like, even to a vented enclosure. The performance of many small sets can be improved out of sight simply by feeding their output into a good speaker system. This is a special application, however, and required less frequently than a second small speaker to provide listening elsewhere in the home.



Illustrating in diagrammatic form the connections between the voice coil of a typical loudspeaker and the switch panel.

A final point concerns the provision of a volume control for the extension speaker. Though not always an essential feature, it requires nothing more than a low resistance potentiometer and a suitable knob. Any value will do for the potentiometer between about 6 and 30 ohms, assuming the usual 2-ohm voice coil circuit. If a low resistance potentiometer is not immediately available, an old-style filament rheostat can be adapted for the purpose by providing a suitable contact with the free end of the resistance element.

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R.F. Dual Wave Assembly. Permeability Iron-cored both B/C and S/W Coils, 7-22 meg. S/W, 550-1600 KC B/C band. Special cadmium sub-chassis. A.W.A. Air Trimmers, Fixed Mica B/C and S/W Padders fitted. All assemblies pre-aligned on special tester before leaving factory. All coil treated with Trolitul. A.V.C. resistors and condensers, de-coupling resistor in R.F. stage. Easy and comprehensive colour-code and aligning instruction sheet supplied.

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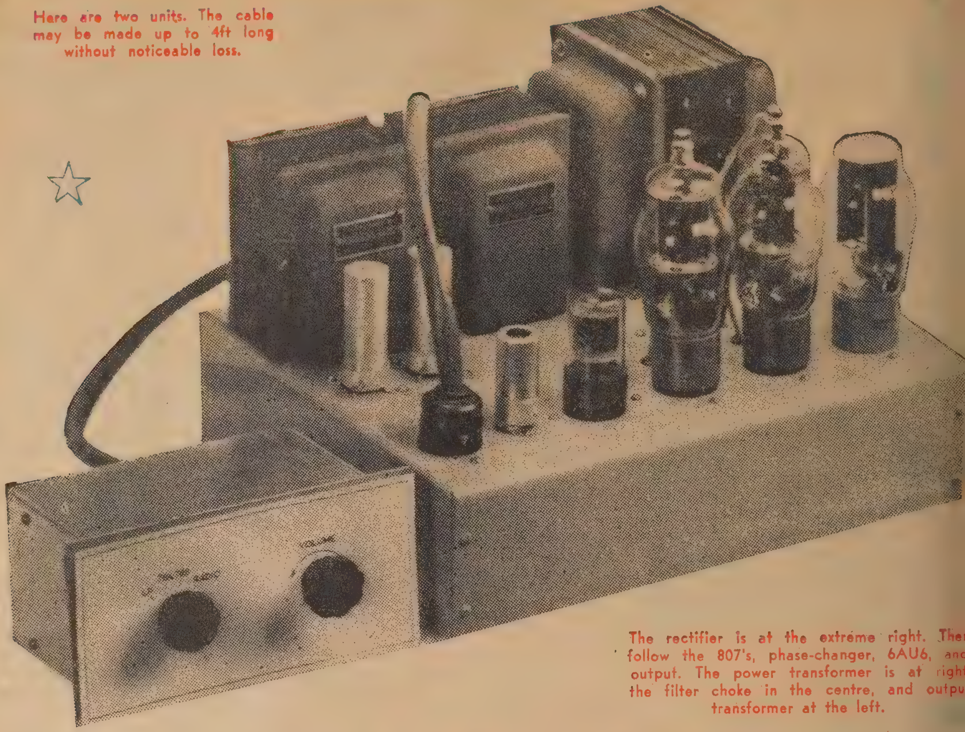
Here are two units. The cable may be made up to 4ft long without noticeable loss.



The rectifier is at the extreme right. Ther follow the 807's, phase-changer, 6AU6, anc output. The power transformer is at righ the filter choke in the centre, and outpu transformer at the left.

A NEW DEAL IN AMPLIFIERS

Some time ago, several members of our staff described their own personal equipment in our technical pages. This month, I am following suit, and have made use of the occasion to introduce a series of articles giving a new approach to amplifier design and construction. In the series will also be included designs for tuning units for use with them.

by John Moyle

BUILDING amplifiers has been one enthusiasm we have always shared with our readers. Ever since electrical reproduction came into being, thousands of keen music lovers and constructors have built up their electric gramophones, tried out various types of pick-ups and speakers, only to see the "perfect" set-up give way to another, and yet another still more perfect.

Battles have been fought over triodes versus pentodes, transformer coupling, direct coupling and resistance coupling. About crystal and magnetic pick-ups. About infinite baffles and vented enclosures.

TODAY'S NEEDS

Today the amplifier business has arrived at the crossroads once more. The circuits and construction of the past are not always good enough for the future. We have arrived at this point not only because technique on the radio side has brought us so many improvements, but also because the long-playing, microgroove record has swept away the old ideas of what can be done.

Up to date, the record has been one of the weakest spots in the chain. The actual music has often been superbly good, but the short playing time, the high surface level, and inner groove distortion of the 78 disc have not allowed us to hear more than a fraction of it in terms of frequency response and dynamic range.

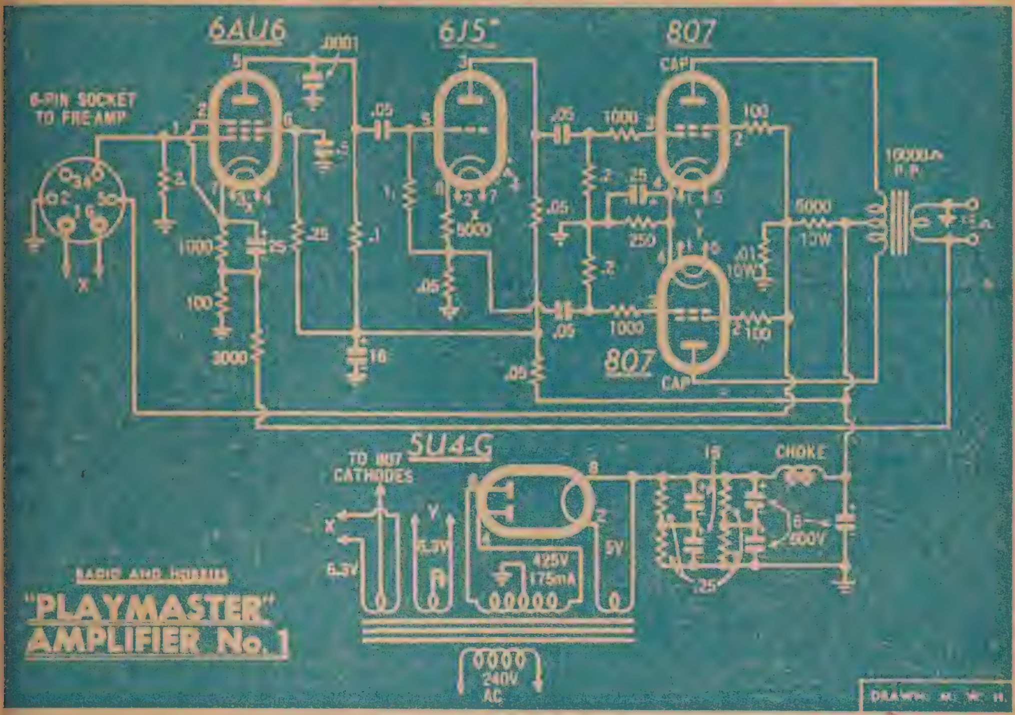
Wide-range amplifiers have had t be severely cut in their upper register, wide range speakers have give out with horrible distortion instea of clean sound. How recording engineers have been handicapped clearly demonstrated by the lates microgroove records with their incredibly low surface noise, extende frequency range, and improve dynamic range. Even better recordings are undoubtedly on the wa

This seems to be a good time t have a look at the amplifier position, to estimate what is require not only of performance and desig but in the layout of the whole system.

BASIC AMPLIFIER

Let us therefore make a quic examination of the things a moder amplifier must possess, commencin with the electrical side.

CIRCUIT DIAGRAM OF THE PLAYMASTER AMPLIFIER



The circuit is fairly simple. Any standard triode can be used as a phase-changer—ours was one section of a 6SN7-GT. Because there is plenty of room, all resistors carrying current should be 1 watt. Coupling condensers should be 600 volt types. The feedback constants are for 15ohm voice coil.

First of all, we need a basic, wide-range, flat amplifier. It must be wide-range because we are hoping (if our pick-ups and speakers are good enough) to hear reproduction covering substantially the whole scale of audible frequencies, or as near to it as circumstances allow and/or require. But even more than just a wide response we need a flat response—one free from dips and peaks.

Second we want an amplifier with a distortion so much below that contributed by other sources that it doesn't matter.

We want an amplifier with enough audio output to avoid overloading on peaks at the volume we desire to play it.

Our amplifier must have a hum level substantially zero—so low that with the gain control at ordinary level we won't be able to tell whether it is turned on or off.

It must have a low output impedance so that we get good loudspeaker damping and good transient response.

RESPONSE

It must give the output we want from any of the standard types of pick-up, magnetic or crystal. It must provide the correct compensation for all types of records we wish to play.

It must be perfectly stable with no motorboating or high frequency oscillation to plague us and spoil our results.

On the mechanical side it must be easy to make and service. It must be handy to control and easy to instal. It must be suitable for the connection of a radio tuner, either standard or wide-range.

Maybe we should stop at this point and see how all these things add up.

It isn't very hard to make an amplifier, either large or small, which has a flat frequency response. A really good output transformer is required, of course, but the rest isn't hard. The trouble is that when we try to accommodate all the other points as well, we often run into trouble.

INSTABILITY

Applying our remarks for the time to the high-powered amplifiers, such a one being the subject of this article, we have a good example of this possible trouble in the Williamson design. I am not trying to buy an argument on this point—I am merely describing the position as I have found it.

This amplifier undoubtedly is, on paper, one of the best designs one could desire. Properly built it is as flat as a board from virtually zero to a long way above audibility. Its distortion is extremely low — so low that it is difficult to measure. It has little or no hum, and plenty of output. It also costs a great deal of money.

Unfortunately for the man who builds one, he often runs into trouble. Due probably to carrying a high degree of feedback over too many stages it has a tendency to motorboat due to a peak at about two cycles per second, which often is cured only by reducing feedback or frequency response. It appears susceptible to high frequency oscillation when connected to a pre-amplifier, even when precautions are taken to ensure that the connection is not predominantly capacitative—a matter we found quite important. And if very much bass boost is applied to it, the low frequency instability becomes almost uncontrollable.

By dint of a great deal of work, isolation of pre-amplifier stages, and the use either of a separate power supply or voltage regulation, I managed to get my Williamson to work well. But what a collection of components went into the final job!

EXTERNAL DISTORTION

Now I am one of those who believes that there is nearly always a simpler way. I couldn't help feeling that this belief applied to an amplifier of this kind.

But if I can ever make the perfect amplifier without resorting to unreasonable circuit demands and cost I will always make it. I also believe that it is good design to fully appre-

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PF 125	240	6	250	60	6.3V @ 2A	71/11
PF 119	240	6	325	125	6.3V @ 4A	102/5
PF 182	240	12	200	40	12.6V CT @ 1A	61/5
PF 126	240	12	250	60	12.6V CT @ 1A	71/11
PF 146	200,30,40	12	325	150	12.6V CT @ 2.5A	120/9

FILTER CHOKES

	Induct	D.C. Res.	M.A.	Retail
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CF 102	15	300	60	25/8
CF 103	30	420	60	48/2
CF 104	30	580	75	51/2
CF 105	15	250	80	43/1
CF 106	12	200	100	43/8
CF 107	30	360	100	59/2
CF 108	12	135	150	61/7
CF 109	20	225	150	64/3
CF 110	12	100	200	74/8
CF 111	16	165	200	74/8
CF 112	10	70	250	74/8

SPECIAL CHOKES

CF 113	.5	70	250		
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OP23	3250 SE	12.5, 8.4, 2.1	10	112/3
OP19A	5000 PP	12.5, 8, 2.3	15	163/5
OP51	4500 PP	15.5, 12.5, 8.6, 2.7, 2	20	153/3
OP63	10000 PP	15, 3.75	15	174/6
OP64	10000 PP	12.5, 3.125	15	174/6
OP65	10000 PP	8.4, 2.1	15	174/6

OUTPUT TRANSFORMER TO VOICE COIL

Special Full Frequency (20-30,000)

OP25/40	10000 PP	40, 10	15	183/4
OP25/16	10000 PP	16, 4	15	183/4
OP25/15	10000 PP	15, 3.75	15	183/4
OP25/12	10000 PP	12, 3	15	183/4
OP25/10	10000 PP	10, 2.5	15	183/4
OP25/8.4	10000 PP	8.4, 2.1	15	183/4
OP66	5000 PP	8.4, 3.7	15	219/6
OP67	5000 PP	15, 6.5	15	219/6

OUTPUT TRANSFORMER TO LINE—

Full Freq. Range

OP22	3250 SE	500, 125, 2.3	10	112/3
OP19b	5000 PP	500, 250, 125	15	163/5
OP21	8000 PP	500, 250, 125	15	133/6
OP62	10000 PP	500, 125	15	174/6

OUTPUT TRANSFORMER TO LINE—

Special Full Freq. Range

OP25/500	10000 PP	500, 125	15	183/4
OP25/250	10000 PP	250, 62.5	15	183/4

VIBRATOR TRANSFORMERS

Code No.	Pri. V.	D.C. Out.	M.A.	Buffer Full Sec.		Retail
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VT 101	6	90	15	.008	„	39/11
VT 102	6	150	25	.005	„	46/6
VT 103	6	200	50	.005	„	49/-
VT 104	6	250	60	.005	„	50/2
VT 105	12	250	60	.005	„	51/11
VT 106	6	300	75	.008	„	82/10
VT 107	6	250	60	.005	Sync. Low Rad.	54/10
VT 108	12	90	15	.008	Sync.	41/5
VT 109	24	90	15	.008	„	43/9
VT 110	12	150	25	.005	„	49/-
VT 111	24	150	25	.005	„	53/8
VT 112	12	200	50	.005	„	51/4
VT 113	24	200	50	.005	„	51/4
VT 114	12	300	75	.008	„	89/3
VT 115	24	300	75	.008	„	90/3
VT 116	24	250	60	.005	„	57/2
VT 117	12	250	60	.005	Non Sync. Low Rad	55/5
VT 119	32	150	25	.005	Sync.	49/2
VT 121	6	180	30	.005	„	51/4
VT 122	6	400	50	.005	„	83/10
VT 123	12	320	125	.005	Sync.	107/10
VT 124	32	250	60	.005	„	56/-
VT 127	6	200	50	.005	Sync. Low Rad.	51/4
VT 128	12	250	60	.005	Sync. Low Rad.	60/8

RECEIVER POWER TRANSFORMERS

Code No.	Prim.	HTV Aside	M.A.	Filaments	Retail
PF 185	240	150	30	6.3V @ 2A	50/2
PF 106	240	325	45	6.3V @ 2A, 5V @ 2A	53/11
PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	50/2
PF 151	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	60/8
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	66/6
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	72/2
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	69/5
PF 130	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	77/9
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	87/3
PF 152	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	97/6
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	109/2
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	102/5
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	127/9
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	197/9
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	185/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3V @ 3A, 5V @ 3A	243/7
PF 201	240	225	50	6.3 @ 2A	51/1

LINE TO VOICE COIL TRANSFORMERS

	Pri. Imped.	Sec. Imped.	Watts	Retail
MT111	500	12.5, 8, 2.3	10	69/1
MT100	600	4, 3	15	64/2
MT101	500	15	15	64/2
MT124	600, 500	4, 3, 2.7, 2.3, 2	25	107/10
MT125	600, 500	15, 12.5, 8.4, 6.5	25	105/2

MODULATION TRANSFORMERS

MT118	8000, 6000 PP	10000, 7000 5000	25	169/4
MT119	8000, 6600, 3800 PP	10000, 7500, 6500 5500, 4500, 3500	50	195/1
MT120	500 to 20000 in steps.	500 to 30000 steps.	50	356/10
MT121	500 to 20000 in steps.	500 to 30000 steps.	125	444/-

Output Transformer To Voice Coil—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1	5000, 2500 SE	12.5, 8, 2.3	10	71/3
OP54	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	10	82/3
OP39	5000, 2500 SE	15	10	72/6
OP33	5000, 2500 SE	5, 2.7	10	72/6
OP41	5500 SE	3.7	10	81/1
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP	2.3	10	70/1
OP2	5000 PP	12.5, 8, 2.3	15	109/11
OP55	5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP3	6600 PP	12.5, 8, 2.3	15	109/11
OP56	6600 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP4	10000 PP	12.5, 8, 2.3	15	109/11
OP57	10000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	120/5
OP5	10000, 6600, 5000 PP	12.5, 8, 2.3	15	109/11
OP58	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	121/11
OP59	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	25	152/9
OP60	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	32	195/-

OUTPUT TRANSFORMER TO LINE—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1A	5000, 2500 SE	500	10	71/3
OP44	5000, 2500 SE	500, 250, 125	10	84/8
OP34	5000 PP	600, 300, 200, 150, 130, 100 75, 50	15	131/-
OP6	5000 PP	500, 250, 125	15	109/11
OP7	6600 PP	500, 250, 125	15	109/11
OP50	8000 PP	600, 300, 120, 60, 30	15	228/4
OP8	10000 PP	500, 250, 125	15	109/11
OP8M	10000 PP	500, 250, 160, 125, 100, 83.5 71.5, 62.5, 55.5, 50	15	118/6
OP9	10000, 6600, 5000 PP	500, 250, 125	15	109/11
OP10	5000 PP	500, 250, 125	25	132/6
OP11	6600 PP	500, 250, 125	25	132/6
OP38	6600 P	600, 300, 250, 200, 170, 150 76, 50, 36, 27,12.5, 7.5,3.6, 2.7	25	228/4
OP12	10000 PP	500, 250, 125	25	132/6
OP13	10000, 6600, 5000 PP	500, 250, 125	25	132/6
OP35	10000, 6600 PP	500, 4000, 8.4, 2.2	25	187/4
OP14	5000 PP	500, 250, 125	32	161/-
OP48	6600 PP	140, 70	32	195/1
OP15	6600 PP	500, 250, 125	32	161/-
OP15M	6600 PP	500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50	32	162/6
OP16	10000 PP	500, 250, 125	32	161/-
OP17	10000, 6600, 5000 PP	500, 250, 125	32	161/-
OP36	3800 PP	17.6	60	171/-
OP18	3800 PP	500, 250, 125	60	173/4
OP61	3800 PP	100, 75, 50, 25, 10, 5, 2	60	223/-
OP37	6400 PP	500, 250, 125	80	236/3
OP49	8800, 6000 PP	500	105	355/10
OP20	11600, 8400 PP	500, 250, 166, 125	150	451/-

ALL PRICES SUBJECT TO ALTERATION WITHOUT NOTICE ciate what we really require of our equipment before deciding how far short of perfection it is permissible to fall.

For instance, it is very nice to know our amplifier has a total harmonic distortion of 05 pc or some such. It would be nicer if we knew that we could tell the difference between it and one with a figure of .5 pc. But can we?

Now a good pick-up is hardly likely to contribute less than 3 or 4 pc distortion. Our loudspeakers will add a good deal more than this—even the best of them. The records, too, will unavoidably add a further percentage. The total figure will reduce our .5 pc amplifier to easily the most distortionless link in the whole chain.

I have put this point to the test by comparing a number of amplifiers during the last few weeks. They have included the Williamson, a two-valve job of good design, a famous commercial amplifier built in England which appears to support its high reputation, and the amplifier described here. My pick-up and speaker units are both wide-range high-grade devices much better than the average and probably as good as the best our readers are likely to use. Could I tell the difference at normal room volumes? I could not. They all sounded equally good.

RESERVE POWER

The same general position applies to frequency response. It isn't absolutely necessary to carry a flat curve down to zero and up to 50 Kc. If we are still within a db or two of reference between 50 cycles and 15,000 cycles even the best input and output won't know the difference. Some readers would allow even more latitude than this. But for me 50 cycles is awfully low and 15 Kc is awfully high. If I could make a more stable equipment by letting my amplifier fall away any amount outside this range I wouldn't worry about it at all.

The fact that the amplifier described here is a good deal better than the abovementioned limits isn't inconsistent. It just means that in this case the amplifier was stable without any pruning. Other designs might need a little and still be good.

Concerning output, I like a big outfit to have plenty in reserve. This is particularly true if bass and treble boosting is used. An amplifier to be played at an average of four or five watts won't find a peak output of 15 or 16 watts too much. It's even more particularly true if wide range is used. No possibility of overloading can be tolerated, and adequate reserve is one of the best guarantees of low distortion.

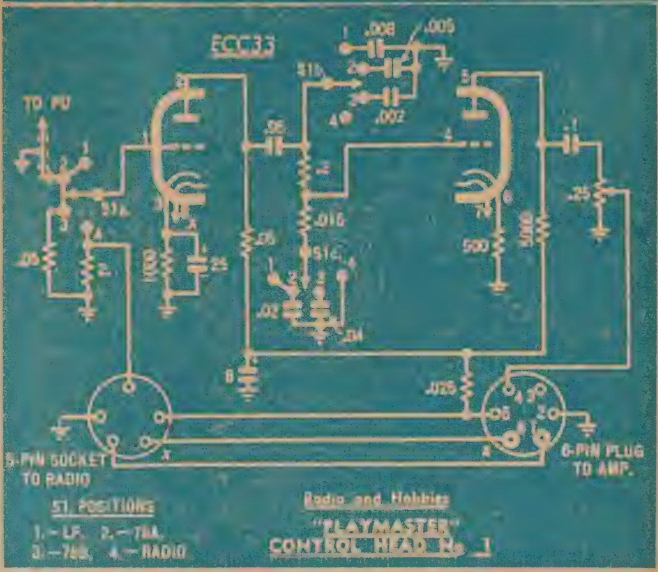
INPUT RATING

Hum of any kind just has no place at all in a good amplifier. If you can hear any hum more than a foot away from the speaker under operating conditions that's too much. When the music stops only complete silence can be tolerated.

Later on these technical points will be picked up when describing circuits. A word now about the constructional side.

Any good amplifier today must cater for the high grade lightweight pick-up which will play both standard and microgroove records. More of these pick-ups are bound to become available before long. It should also be usable with good crystal pick-ups.

CIRCUIT OF No. 1 CONTROL UNIT

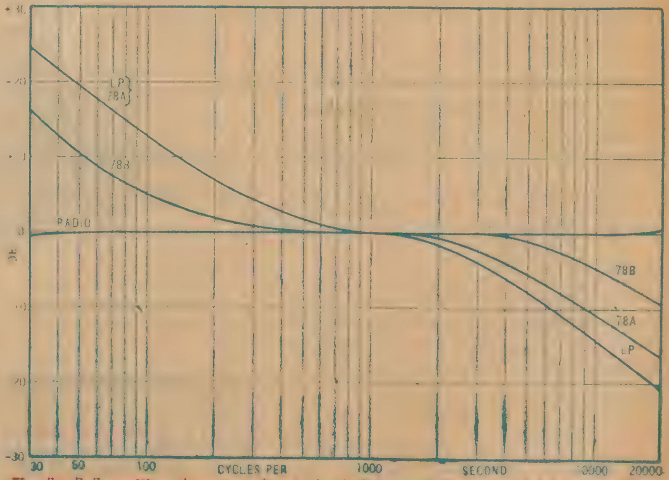


Connection to preamplifier should be by a plug, the socket being connected to the cable. The vacant connection could be used for an extra 400 volt lead for the tuner if required later on.

To cater for them all our amplifier must give its full output, or at least all we require, with an input of about 100 millivolts or less. It must also allow compensation for the various types of records, which involves bass boosting up to about 15 db at 50 cycles. That's one reason we must guard against hum, for it means about seven times as much gain at 50 cycles as at the middle and high frequencies.

It should also allow for extra bass and treble boosting, at least in "de-luxe" models, although personally I am not so insistent on this point. It must also cater for a radio tuner to be selected by the same switch as selects the correct compensation. Finally its volume control must be silent, smooth and have no effect on frequency response.

Undoubtedly the best way to effect all these things is to adopt unit construction, a method which is becoming so popular overseas. This involves a basic amplifier and power supply, a separate control panel connected to the amplifier by a single cord and suitable for mounting on



The "radio" position shows an almost dead flat curve. Degrees of boost and top cut are shown by the others. Curves were taken from input to 16 ohm resistance load across the voice coil winding.

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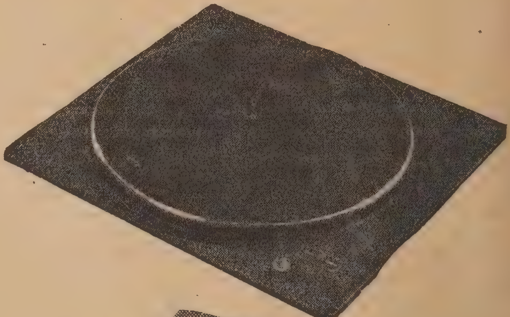
"Sound Quality" PRODUCTS

R33 PORTABLE DUAL SPEED MICROGROOVE RECORDER AND PLAYBACK UNIT

Where there's a three pin power socket —there's your recording studio. Completely self-contained microgroove disc recording unit with five functions:—

1. Record from Microphone.
2. Record from External Source (Radio Tuner).
3. Reproduce from External Source.
4. Reproduce from Recordings and Commercial Pressings.
5. Public Address System — Reproduce from Microphone.

T25 SUPER-SILENT DUAL SPEED TURNTABLE



. . . . . Developed primarily for the discriminating enthusiast, the T25 is the quality instrument of the playback field. No rumble . . . . . no flutter . . . . . no "wow" . . . . . just a continuous flow of smooth power for both microgroove and standard recordings.

R-12-D Dual Speed Microgroove RECORDER & PLAYBACK UNIT

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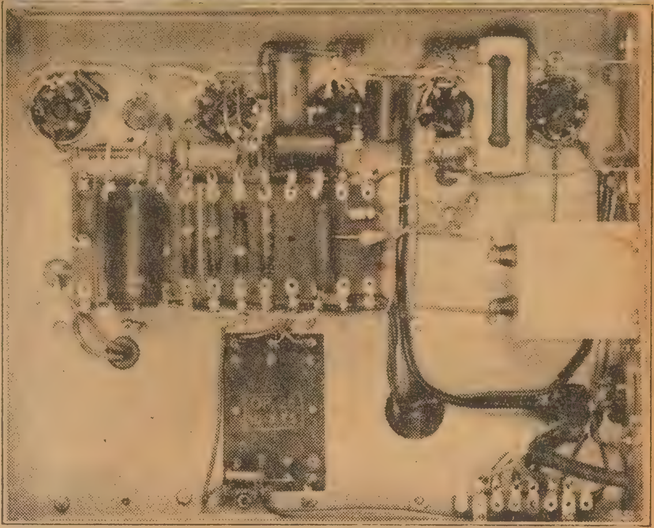
LAYOUT OF AMPLIFIER CHASSIS



The components are mounted on a large terminal strip — others connect to smaller strips direct from the valve sockets. Above the chassis are two 16 mfd condensers—one of these in the decoupling circuit of the two first valves. Note the 4 mfds paper condenser which may be replaced by electrolytics or increased in value for lower hum.

the motor board or some other convenient position, and lastly a tuning unit which may also be mounted independently of the other two units.

This type of construction isn't new to Radio and Hobbies—it was used by Neville Williams in his own "personal" equipment described some two years ago. In my case I have adopted the same system but with rearranged controls to provide the now essential compensation selector switch.

Summing up all the foregoing I propose to describe in this and following articles the actual equipment I use myself for radio and records. It will be followed by others designed to the same requirements but including a push-pull and single-ended 6V6-GT or 6AQ5 amplifier, a more elaborate control panel and one or more tuning units.

As far as possible these units will be interchangeable, as their functions have been kept separated. In other words any one of the tuners can be used with either of the control panels and any one of the amplifiers.

TRIODE 807's

The net result should be a complete restatement of the amplifier position from top to bottom, which for the time being at least should represent the ultimate in the art!. Do I really believe that? Well, let us say I do, at least for the time being! At any rate it should give our readers quite a bit to think about.

The amplifier itself was constructed from the same kit of parts used for the Williamson, but there the resemblance ends. The power transformer, filter choke and output transformer, obtainable in several well-known makes, are particularly good and admirably suited to requirements.

The 807 volves were retained as being about the best for a high-powered job, but they are used as tetrodes and not triodes.

We have found that push-pull drivers are necessary to drive 807 triodes or similar types if high output is to be obtained with a balanced overload characteristic. In this connection the valves do not operate in pure class A throughout their range, and without push-pull drivers not more than about eight watts was obtainable.

When driven from a phase changer, apparently the wide difference in source impedance between plate and cathode circuits working into high impedance grid circuits prevented anything like the 17 watts obtainable from the triode connection when the 807's ran to grid current. Conversely, with tetrode connection, nearly 20 watts is obtainable using the phase changer, with a well-balanced overload characteristic and driving voltage to spare.

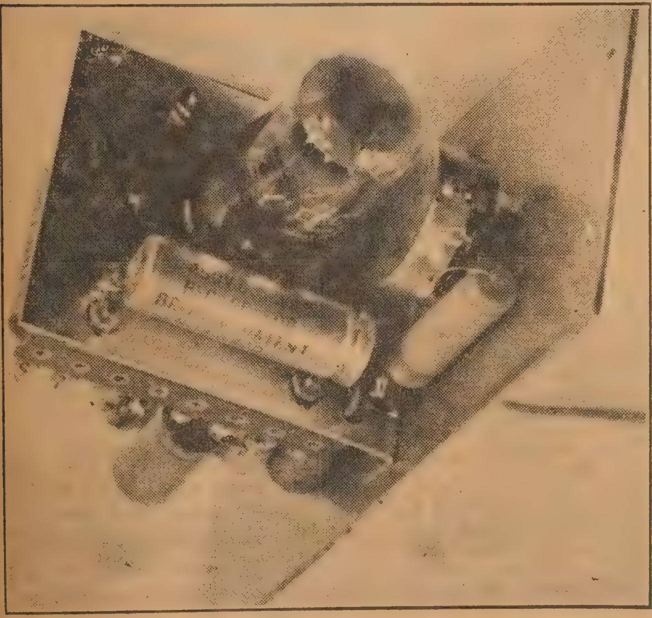
As something over 400 volts is available for the 807 plates, we can fulfil the 10,000 ohms plate to plate load requirements of the output transformer by running the screens at about 250 volts. Actually there is an 807 rating of about 400 volts plate, 270 volts screen, 22½ volts bias, and 9000 ohms load for a quoted distortion of 4 pc at full output of 24 watts. Lowering the screen volts gave us in practice 18 watts, pitched a slightly higher load, and approximated the figures required. The distortion was to be reduced with feedback, which would also provide an extremely low source impedance for the loudspeaker.

FEEDBACK

The phase changer used was one-half a 6SN7-GT, but it may be any triode such as a 6J5, a 6SJ7 triode-connected, or their equivalents. Circuit values will remain the same.

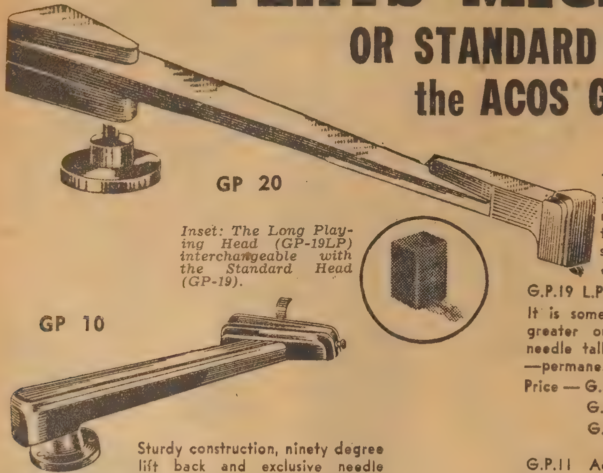
The first valve in the amplifier is a 6AU6. This is chosen to give a high initial gain, so that plenty of feedback can be applied while retaining an input sensitivity of about .7 volts.

This figure was selected for a number of reasons. Too much sensitivity after the volume control has everything against it. Hum pick-up on the



One view of preamplifier shows the valve, 8 mfds midget condenser, volume control and .1 mfd coupling condenser.

PLAYS MICROGROOVE
OR STANDARD RECORDINGS
the ACOS G.P.20 Microcell Pickup



Inset: The Long Playing Head (GP-19LP) interchangeable with the Standard Head (GP-19).

Sturdy construction, ninety degree lift back and exclusive needle pressure adjustment makes this a really outstanding unit in the field of pickups. Has a low harmonic distortion, with an average output of 1.5 volts.

Price £2/19/9
Cartridge only (G.P.9) Price £1/15/-

The G.P.20 pickup is designed for use with the standard 78 r.p.m. records or the 33 1/3 or 45 r.p.m. long-playing microgroove records. To meet these differing requirements, two interchangeable slide-on heads are available.

G.P.19 head supplied as standard.

G.P.19 L.P. head available for microgroove

It is something new in pickup design and has 20 times greater output than comparable magnetic types, while needle talk and motor rumble are practically non-existent—permanent sapphire stylus—wide frequency response.

Price — G.P.20 complete with standard head .. **£5/17/6**
G.P.19 L.P. head £3/7/6.
G.P.19 standard head £3/7/6.

G.P.11 Acos Pickup Cartridge incorporates permanent sapphire stylus. Replacement cartridge for ACOS G.P.12 pickup and many American types. Useful frequency range 25 to 12,000 c.p.s.
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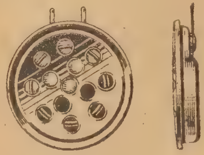
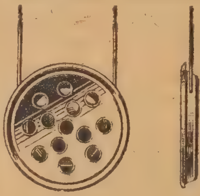


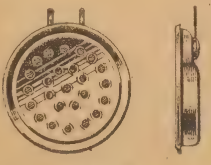
MIC 14

MIC 14 Standard Speech Microphone Insert with nickel-plate brass case which gives high corrosion resistance, mechanical strength and rigidity. Price £1/18/-.



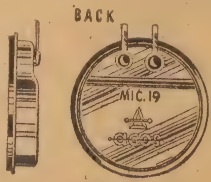
MIC 18

MIC 18 Microphone Speech Insert provides high acoustic qualities with minimum bulk. Where exceptional slimness is required this insert is recommended. Price £1/19/6.



MIC 3

MIC 3 Diaphragm-Actuated Crystal microphone specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity. Price £1/18/-.



MIC 19

MIC 19 Sintercel fulfils the requirement for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction. Price £2/18/6.

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MICROPHONE INSERTS

Crisp, clear-cut reproduction and a host of technical features make ACOS Crystal Microphones the ideal choice for:

Public address: High output, light, yet rugged, may be adapted as a lapel mike.

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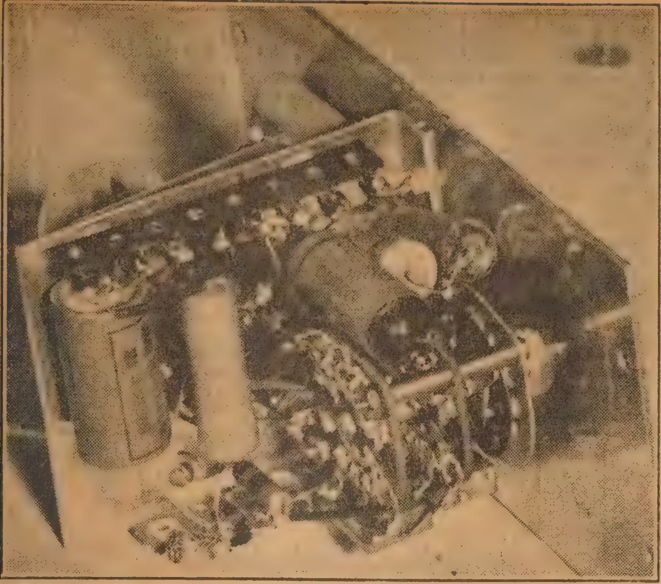

Another pre-amplifier view showing the switch, various components, and two resistor strips carrying connections and resistors. The pickup connects at bottom left, the lead to the volume control comes out at top right.

leads to the amplifier will be more serious, any noises in the control itself will be duly amplified, and even electrical noises such as the 'frig" switching on and off, will often be reproduced with disturbing results.

It is much better to keep the pre-amplification in the control unit, where it is physically and electrically remote from the main amplifier and its power supply.

After much experiment, the circuit values shown were selected to allow about 15 db of feedback from voice coil to 6AU6 cathode, together with the required sensitivity.

FEEDBACK

Feedback over the entire amplifier means the best possible control over distortion, as everything is included. Only three stages are included in the one loop, which is the maximum number permissible without special precautions or trouble. This method pre-supposes an excellent output transformer, and is not recommended with poor types.

A less critical feedback method brings a connection from an output plate to the screen of the pentode. This is very good, but means extra filtering, because the screen can't be decoupled. Our method here makes decoupling easy.

Note that both phase changer and pentode are decoupled through the same circuit. As these points are out of phase, this assists stability rather than anything else. As phase-changer decoupling is essential for low hum, we kill two birds with one stone and reduce the number of components.

The main filter in our case uses a paper condenser bank totalling 14 mfds. at 450 volts working across the rectifier, and a 16mfds 600 volt electrolytic on the far side of the choke. After the rectifier, peak volts will reach about 600, so that if you weren't lucky on the disposals tables, as we were, you may need to use four 600-16 mfds. condensers in series parallel. This is perfectly OK, preferably with a .25 meg resistors across each of the condensers.

Only one 4 mfd. paper condenser is shown in the photo for clarity. Even without the extra 10 mfds., the hum level is very low, but with it it is virtually inaudible, even with one's head in the speaker. And that's not my favorite spot for listening!

The screens of the 807's are fed through a voltage divider and the resultant 250 volts is connected to the input plug to supply power for the pre-amplifier and tuner. It has a 16 mfds filter condenser to earth at this point.

To guard against heater-cathode hum, the centre-tap of the filament winding for the preliminary valves is connected to the 807 cathodes, thus holding them 22½ volts above earth. Don't earth these filament connections anywhere else.

The other connections to the input or pre-amplifier plug are an earth connection, and input lead to the 6AU6 signal grid, and, of course, the 6.3 volt filaments already mentioned.

DISTORTION

Distortion in the first two stages is very low. Even if they were delivering their maximum voltage it would not be high, and falls away in a proportion greater than that between actual output and maximum output. The 4 pc estimate for the output valves is for full output, and as the amplifier will not normally be used for more than 4 or 5 watts average, it will also be well below this amount.

Bucking even this distortion figure we have a further gain reduction due to feedback of about six times, which results in a reduction of distortion in about the same ratio. It would be safe to say that the distortion at operating volume would be well below 1 pc. Only a few specialised labs. can measure this amount.

N.H.V. KITS

AMPLIFIER CABINETS

These streamlined amplifier foundation units consist of a standard chassis 3" deep with removable top in aluminium. Fitting over the top is a removable cover which has louvres on all sides and handles welded to the ends. Color Grey.

Catalogue No.	W	D	H	Price plus Sales tax
AC1	10"	5"	9"	£1 8 0
AC2	12	7	9	£1 15 9
AC3	17	7	9	£2 3 0
AC4	17	10	9	£3 0 0

SLOPING FRONT

Catalogue No.	W	D	H	Price plus Sales tax
AC SF 1059	10	5	7½	£1 15 9
AC SF 1279	12	7	9½	£1 19 0
AC SF 1779	17	7	9½	£2 11 0
AC SF 17109	17	10	9½	£3 5 6

Metal Utility Cabinets

This line of Cabinet is for housing electronic equipment of all types. It has a fixed back and removable front. Colour Grey.

Catalogue No.	D	W	H	Price plus S. Tax
MC666	6	6	6	8/3
MC596	5	6	9	9/4
MC7810	7	8	10	13/9
MC6712	6	7	12	13/9
MC81010	8	10	10	17/-
MC81112	8	11	12	21/-
MC7915	7	9	15	21/-

SLOPING FRONT

Catalogue No.	D	W	H	Price plus S. tax
MCSF776	7¼	7	6½	11/6
MCSF796	7¼	9	6½	13/9
MCSF7116	7¼	11	6½	16/-
MCSF8138	8½	13	8	19/3

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FOR YOUR INFORMATION

The "Q Plus" range of Intermediate Frequency Transformers is of such proportions that it is felt that you, the consumer, should be advised of the characteristics of each type.

For some types the demand is small or are supplied to Government departments, manufacturers, etc., and if you particularly require that type it may have to be specially ordered by your distributor—others are stocked by all good distributors.

But first a little on the construction of these units. Experience has shown that the negative temperature coefficient ceramicon condensers are by far the most reliable for I.F. transformer use and although their cost is higher we are always anxious to place quality above price. Secondly after long experimentation in humidity ovens we are of the opinion that our specially-selected polystyrene varnish is the most satisfactory for tropic and semi-tropic conditions. Each I.F. transformer is now subjected to an oscillographic test assuring that "Q" gain and bandwidth, etc., are well up to standards.

Although not yet released this is the first announcement of our revolutionary new non-softening base with silvered plated contact pins, replacing the conventional wire pins. For months we have investigated every type of solder tag and at last we feel that we have the tag which will speed up wiring and make dry joints a thing of the past.

"Q PLUS" I.F. TRANSFORMER SPECIFICATIONS

TYPE NO.	First or Second I.F.	I.F. Frequency	F.M. or A.M.	Winding "Q"	* Coupling	Construction	Tuning Capacity Used	Physical Size	Remarks
Q+ IF 1	First	455Kcs.	A.M.	120	.8Kc.	Spheroclad	110uufd	$\frac{3}{4}$ x $\frac{3}{4}$ x $1\frac{7}{8}$	AC or Batt.
Q+ IF 2	Second	455Kcs.	A.M.	120	.9Kc.	Spheroclad	110uufd	$\frac{3}{4}$ x $\frac{3}{4}$ x $1\frac{7}{8}$	AC or Batt.
Q+ IF 3	First	455Kcs.	A.M.	120	.8Kc.	Single pi	100uufd	$1\frac{3}{8}$ diam. x 3	AC
Q+ IF 4	Second	455Kcs.	A.M.	120	.9Kc.	Single pi	100uufd	$1\frac{3}{8}$ diam. x 3	AC
Q+ IF 8	First	455Kcs.	A.M.	145	.8Kc.	Spheroclad	100uufd	$1\frac{3}{8}$ diam. x 3	AC or Batt.
Q+ IF 9	Second	455Kcs.	A.M.	145	.9Kc.	Spheroclad	100uufd	$1\frac{3}{8}$ diam. x 3	AC or Batt.
Q+ IF 10	First	455Kcs.	A.M.	140	.85Kc.	Triple pi	80uufd	$1\frac{3}{8}$ diam. x 3	Batt.
Q+ IF 11	Second	455Kcs.	A.M.	140	.95Kc.	Triple pi	80uufd	$1\frac{3}{8}$ diam. x 3	Batt.
Q+ IF 12	First	1600Kcs	A.M.	90	.7Kc.	Triple pi Spheroclad	80uufd	$\frac{3}{4}$ x $\frac{3}{4}$ x $1\frac{7}{8}$	AC or Batt.
Q+ IF 13	Second	1600Kcs	A.M.	90	.8Kc.	Triple pi Spheroclad	80uufd	$\frac{3}{4}$ x $\frac{3}{4}$ x $1\frac{7}{8}$	AC or Batt.
Q+ IF 15	First	1900Kcs	A.M.	140	.4Kc.	Double pi	100uufd	$1\frac{3}{8}$ diam. x 3	AC or Batt.
Q+ IF 16	Second	1900Kcs	A.M.	140	.5Kc.	Double pi	100uufd	$1\frac{3}{8}$ diam. x 3	AC or Batt.
Q+ IF 17	First	4 M/cs.	F.M.	80	.8Kc.	Progressive	100uufd	$\frac{3}{4}$ x $\frac{3}{4}$ x $1\frac{7}{8}$	AC
Q+ IF 18	Discrim.	4 M/cs.	F.M.	80	——	Progressive	100uufd	$\frac{3}{4}$ x $\frac{3}{4}$ x $1\frac{7}{8}$	AC

*** The coupling coefficient here allows for certain stray circuit capacities.**

HINTS ON I.F. TRANSFORMER USE

When an I.F. transformer "looks" into a diode, the winding is shunted by the diode and its load resistor, this is usually about $\frac{1}{2}$ meg ohm but has an effect equivalent to placing about 100,000 w across the secondary of the I.F. transformer. This will drop the "Q" factor of the winding and if arrangements were not made to make up for this the co-efficient of coupling would be greatly decreased. I.F. transformers made by "Q Plus" overcome this difficulty by decreasing the physical distance between the two windings, thus if a No. 2 I.F. is used where a No. 1 should be—over-coupling may result and if a No. 1 is used where a No. 2 should be—under-coupling will result. **Therefore always be sure you receive the correct I.F. types.**

Should you be desirous of using two I.F. stages, then appropriately you should choose two first and one second I.F.

"Q Plus" I.F.'s come already aligned but should this, for some reason be upset, always align to the peaks where the core is in its outermost position; it is sometimes possible to obtain an inner peak but ths will alter the correct coupling coefficient.

Always align I.F.'s through a valve never straight on to the I.F. itself as the loading created by the oscillator will make peaking impossible.

RECOMMENDED TYPES

AC midget, Battery Personal Portables, &c., or other sets where size must be kept small, including car radios . . . . I.F. 1 & 2.

General Purpose, High Gain, A.C. Equipment . . . . I.F. 8 & 9.

General Purpose, Low Gain, A.C. Equipment . . . . . I.F. 3 & 4.

High Gain Portables where space is available and battery or vibration sets for country operation . . . . I.F. 10 & 11.

ALWAYS USE "Q PLUS" AND BE SURE

R. W. STEANE & CO. LTD., AUBURN, VIC.

The second unit is the pre-amplifier which is constructed to be completely separated physically from the amplifier proper. Not only does this make for flexibility but allows important electrical advantages.

The input sensitivity of the total equipment is 90 millivolts, low enough to make precautions necessary against hum injection into high gain circuits. When it is remembered however that pickup compensation calls for an additional gain of about 6 times (15 db at 50 cycles), we realise that the effective sensitivity at the fundamental hum frequency is about 15 millivolts.

For this reason every precaution must be taken. One of the most valuable is to see that there are no earth circuits which can introduce hum into the input because of common currents in the chassis or wiring.

EARTH LOOPS

It is extremely difficult to avoid this happening when a high gain amplifier and power supply is mounted on one chassis, particularly a steel chassis. Physical separation not only allows us to avoid such hum "earth loops," but helps to remove sensitive components from the vicinity of transformer fields which can radiate over considerable distances.

In the preamplifier chassis, the only AC introduced is via the filament windings which in any case are not connected to it. The extremely low impedance of the filament circuit, and its tightly twisted wires, makes direct pickup unlikely particularly, as the grid leads are kept well away from them.

Ideally, each of the two circuits should have its respective earth points connected to two insulated lugs, which are then earthed to a single point by separate wires. In practice we haven't found this necessary, and it seems quite OK to make earth connections to the most convenient points. The separate earth point technique might be a little hard in the rather confined space.

The efficiency of the construction method can be tested by connecting the braid of the pick-up lead to the amplifier chassis when the equipment is working. In all cases, considerable hum will be introduced, varying in strength according to the spot on the main chassis used for the test.

The pre-amplifier performs two functions, and uses a double-triode for them. The first of these sections provides a stage with a gain of approximately two times at 1000 cycles and, by means of the voltage divider in the plate circuit, gives the degrees of bass boost necessary for pickup compensation. Bypass condensers switched from the plate of this section gives the necessary treble attenuation or de-emphasis.

COMPENSATION

These two things are needed because the limitations of recording require bass attenuation to avoid over-cutting the record grooves. We have to restore this by boosting. In practice, the British 78 records require about 12 db boost at 50 cycles and American 78 and LP records about 17 db. There are variants on these figures which make it impossible to cater for all cases, and even disagreement on standards. The constants we have used will be found quite acceptable, and could be varied by constructors who know what they are doing.

Similarly de-emphasis is needed particularly with the American 78's and LP records. The latter require about 15 db cut at 10 kc and many bad reports of these records are due to the de-emphasis being omitted. The American 78 requires about 10 db, and the British, although generally recorded flat at the top end, generally sound better with about 5 db drop at 10 kc. These are the figures aimed at in our circuit.

The commencement of the bass "roll-off" for the two settings isn't the same, the British starting at 250 cycles, and the others at 1 kc. This is approximated by the values used, and the extra boost which follows the latter is enough without altering the ratio between the .2 meg and .015 meg resistors, which actually sets the amount of boost.

Pre-emphasis is used in recording to reduce effective surface noise by increasing the signal noise ratio. It brings the music down to its original balance, but the surface noise undergoes a straight reduction equal to the corresponding de-emphasis used.

Some of the locally pressed American 78's have been corrected to correspond with the British curve. Therefore, with three choices, use the one which sounds best.

This part of the circuit is not there for "tone control." It serves to bring magnetic lightweights back to "reference." Crystal pickups, if connected into the amplifier, and thus facing a load of 50,000 ohms, behave very much like magnetics. Their output is reduced together with bass response, so that, generally speaking, any type of modern pickup can be connected with satisfactory results.

The second valve section is used to provide a small amount of extra gain to fully load the main amplifier This it must do with the gain control only part way on to give sufficient tolerance for various pickup levels. It has a gain of about four times, making about 8 for the pre-amplifier at 1kc.

This is accomplished by using a low plate load and providing current inverse feedback from an unbypassed cathode resistor. This is a simpler method than using standard circuitry and throwing away nearly all the gain by a second voltage divider.

Overall distortion is low because of the low voltages handled. The first valve accepts only about .1 volt and with a gain of about 25 delivers about 2.5 volts. It can, however deliver about 40 volts with three or four pc distortion, so that its con-

(Continued on Page 71)

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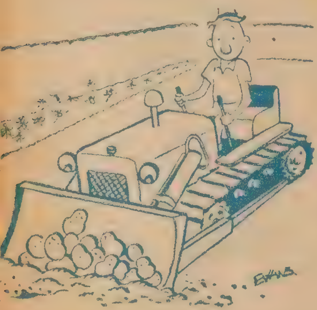
Here's your answer, Tom!

Our "Tom" for this month is actually a young lass who is studying for her amateur operator's licence. She is attending the local WIA classes and the last lecture was on transmitter modulation. However, there are still a few points she would like to revise so that our questions for this month centre round this subject.

"TOM" has heard a lot of talk about 100 pc modulation and the evils of exceeding it, but she still has some oubts. She asks—

What is 100 pc modulation, and what happens if you exceed 100 pc modulation?

First of all let us visualise a steady arrier wave being broadcast by a ransmitter when there is no modulaion. The aerial radiates countless ycles of radio frequency energy. Say, or instance, the transmitter is oper-



ting at a frequency of one megaycle (one million cycles per second), hen, in one second, the transmitter adiates one million little pieces of adio frequency energy. Each one is xactly the same as the one that vent before it and the one that folows it.

This is all very well, but it doesn't elp the chap listening on the reeiver at the other end. To be sure, he meter in his receiver indicates hat the steady carrier wave is preent, but this really isn't much help vhen it comes to sending a message.

CW SIGNALS

You can actually send messages ust using the simple carrier wave lone, by switching it on and off ccording to a prearranged code. For xample, in your case, "Tom," four hort signals could mean, "It's okay or the flicks tonight." Elaborate on his system a little and you have the orse code!

That's all very well, but it still oesn't enable you to hear the anouncer's voice coming from the ther end. This is where the "moduation" system comes in, whereby the arrier strength is varied in sympathy vith the tones and strength of the uman voice.

To do this, it is necessary to amplify the weak pulses from the microphone so that they are of strength comparable with the RF signal. The amplified audio is then applied to the transmitter so that the RF signal output varies in sympathy with the original voice pulses.

One of the easiest ways to do this is to apply the amplified audio voltage to the radio frequency amplifier valve feeding the aerial, so that when the strength of the signal from the microphone increases, the strength of the radio frequency signal being radiated increases also. In effect, we have superimposed the audio frequency from the microphone on the radio frequency signal generated by the transmitter.

The process of detection at the receiving end is simply a reversal of the modulation process. We really only use the carrier wave because it possesses the property of travelling quickly and easily over long distances.

MODULATION

As you can easily imagine, Tom, if we make the audio signal too strong, it could make an awful mess of the carrier wave. Imagine what would happen if you were to use a bulldozer to dig up "spuds" in the backyard!

The idea is to make the audio signal just strong enough to double the strength of the carrier pulses on peaks and bring it to zero on the troughs. This is 100 pc modulation. If you more than double the strength of the carrier on peak you will certainly send out a louder signal but you may also break the carrier altogether on troughs. This causes unwanted signals to be radiated, much to the radio inspector's disapproval.

How do I know when I am modulating 100 pc?

There are actually several makeshift ways of measuring modulation percentage, Tom, but we suggest that you use a cathode ray oscilloscope because, apart from measuring the percentage of modulation, it will tell you a number of other important things about your transmitter.

We won't attempt to explain the setting up of the oscilloscope just now but it is possible to arrange a pattern on the screen which tells you at a glance just how much you are modulating and also whether the modulation is distorted or not. You will probably learn about this later on in your course, Tom.

Experimenters tend to be a little frightened of CRO's but they are really quite simple. For adjusting modulation the oscilloscope need only consist of the tube, and one or two potentiometers for adjustment. It is even possible to obtain the supply current for a small tube from the transmitter itself. If you care to check with current amateur handbooks you will find several such oscilloscopes described.

How do you know when an FM transmitter is 100 pc modulated?

The answer, Tom, is of the sour, citrus variety. You see, with FM there is no such thing as 100 pc modulation in the accepted sense of the term.

The carrier wave maintains a constant strength but its frequency varies in sympathy with the signal from the microphone. A weak signal causes the carrier wave to vary slightly in frequency while a strong signal causes it to vary greatly.

We can't go into it in great detail here, but if the FM receiver were capable of receiving the signal it would be possible to go on increasing the frequency deviation ad lib.

Many FM communication systems work on the basis of a maximum deviation of 15 Kc, while high fidelity FM broadcast stations may deviate up to 75 Kc with better noise reduction and fidelity characteristics. The former occupies a nominal 30Kc channel in the spectrum and the latter a 150 Kc channel.

SIDEBANDS
EVANS

In the case of an AM transmitter where do the sidebands come from? As I see it, there can only be the carrier and the audio frequencies.

Don't confuse the sidebands with decorations on the bandsman's trousers. Radio sidebands wouldn't be half as decorative.

The sidebands in a transmitter are formed by a heterodyne process in much the same way as the intermediate frequency in a superhet receiver is generated by the beating together of a signal frequency and the local oscillator frequency. Say, for instance, that the transmitter is operating on a frequency of one megacycle and being modulated by a frequency of 1000 cycles. The audio signal beats with the carrier wave to produce both the difference (.999Mc) and the sum (1.001Mc).

If you had an extremely selective receiver you could actually tune in these three high frequency waves separately. As you tune across the band, you would hear first one sideband, then the carrier, then the other sideband.

However, we deliberately design the receiver so that it responds to all three signals at one and the same time. By the reverse heterodyne process in the detector we hear a reproduction of the 1000-cycle note from the microphone.

We were talking about the same thing when answering your first question, but we were looking at it from a slightly different point of view.

How can you make sure that the sidebands will fall inside the amateur band?

Make sure, Tom, when you are operating on "phone" that your carrier wave is removed from the edge of the band by at least the highest modulation frequency you intend to use.

For communication work it is really not necessary to modulate with a higher frequency than about 3.5 Kc. If, then, you limit the upper modulation frequency to 3.5 Kc, by use of the filters and so on, you can operate within 3.5 Kc of the edge of the band. When your transmitter is modulated at 3.5 Kc one sideband is on the edge of the band, the other sideband is 7 Kc inside. Your whole transmission is occupying a bandwidth of 7 Kc.

SPLATTER

It is important, too, that you do not modulate greater than 100 pc otherwise "splatter" will be radiated outside the allotted frequency band, despite the fact that you are not employing a modulation frequency higher than 3.5 Kc.

What do you mean by "splatter" and what causes it to be generated?

Splatter, or spurious sidebands, are generated when a transmitter is overmodulated. The carrier is completely cut off on the negative peaks and then switched on a few microseconds later. The effect can be compared with that when a light or similar device is switched off and on, producing clicks in a receiver.

Usually the click has no particular frequency and can be heard anywhere on the receiver dial. In the case of a badly overmodulated transmitter, the modulator is completely switching the carrier off and then on again in sympathy with the modulation, a quick succession of "clicks" is radiated by the aerial.

As these "clicks" have no particular frequency they can cause interference to receivers listening on other frequencies.

The moral, Tom, is to keep that modulation within 100 pc.

If cutting the carrier off and on sharply causes interference to be radiated, why doesn't a CW transmitter, operated by a Morse key, cause interference?

We very much regret to report, Tom, that many CW transmitters do cause interference for this very reason. In the case of a CW transmitter it is necessary to completely silence the carrier wave during "key up" conditions. In other words, when the operator presses the key the transmitter must radiate full power but it must not radiate any power when the key is up.

If you follow this ideal to the letter the result will be a vicious series of clicks, for much the same reasons as switching house lights on and off causes clicks in domestic radio sets.

Experience has shown that the clicks can be eliminated by arranging the circuit so that when the key is pressed the carrier wave takes a small fraction of a second to build up to full value and again takes a small fraction of a second to fall to zero when the key is lifted.

This delay must be quite small, otherwise, when the operator is keying at a very fast rate, one character will be still sounding when he is ready to send the next one. Taking an extreme case, the operator at the receiving end would hear a continuous note varying slightly in intensity.

ANOTHER FATHER CHRISTMAS

PROMPTED by the gesture of a reader in the August issue yet another reader has written to say that he has a sundry collection of radio oddments together with unwanted gramophone records which he is willing to present to schoolboys who are not yet in receipt of regular income. The address is Mr. R. Taylor, 45 Myahgah Rd., Mosman, NSW.

Most amateurs find that they obtain best results by designing the keying circuit to have a sharp "make" characteristic and a soft "break." The make should be as sharp as possible without causing a click while the break should be soft but not so soft as to cause successive characters to run into one another.

How do I adjust the keying characteristic of my transmitter?

It's quite simple, Tom. With the usual system of keying only two extra components are required. The sharp make is eliminated by connecting an inductor in series with one of the leads to the key. The larger the value of the inductance the longer the current takes to reach full value.

A capacitor across the terminals of the key allows current to flow in the circuit for a fraction of a second after the key is lifted and so makes the break less sharp. The values of the components are not particularly critical and odd iron cored chokes and capacitors can often be pressed into service. Depending on the impedance of the circuit, the inductance may be between 1 and 30 henries and capacitance between .05 and .5 microfarad.

DEPARTMENT OF EXTERNAL AFFAIRS

ANTARCTIC DIVISION

SUPERVISOR RADIO OPERATOR GR. 1 —

Wanted, Supervising Radio Operator Gr. 1 for each of the Australian Scientific Stations at Heard and Macquarie Islands. Applicants should state any appropriate licence or technical diploma held by them. Thorough knowledge of practical electronics essential. They will be required to service and maintain radio, radiosonde and rewind equipment at the Australian Scientific Station at Heard or Macquarie Island and to act as Senior Wireless-Telegraphy Operator. Salary range £728 to £764, plus special hardship allowance. Period of stay approximately twelve months. Applicants should be young, healthy and interested in outdoor activities, such as walking, ski-ing, mountaineering, etc.

Full details on application to the Secretary, Antarctic Division, Department of External Affairs, Albert Park Barracks, Albert Park, St. Kilda, Melbourne, Victoria.

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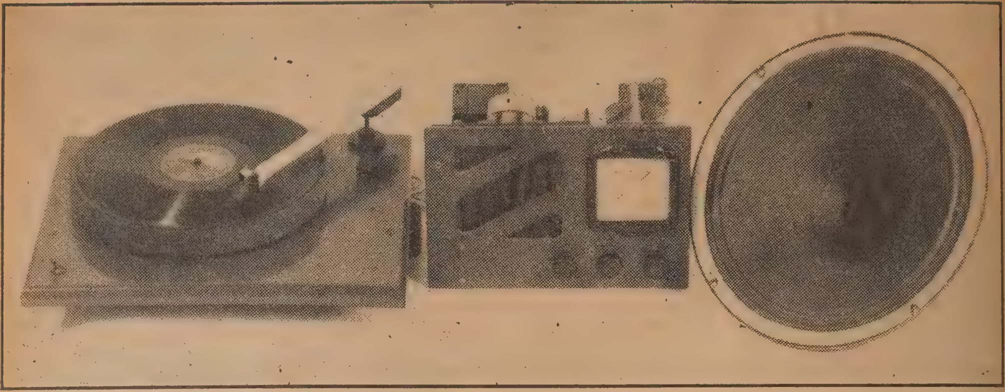
Full details on application to the Secretary, Antarctic Division, Department of External Affairs, Albert Park Barracks, Albert Park, St. Kilda, Melbourne, Victoria.



Here is a suggested complete set up for playing records. At left is a multi-speed motor and crystal pickup, at centre is the receiver, and at the right a 12-inch permag. speaker.

LEARN WHILE YOU BUILD

This month we are leaving the radio side of our set more or less untouched and concentrating on a new phase—record reproduction. In this article we discuss pickup characteristics, recording characteristics, and some of the problems of speakers, transformers, and baffling. Altogether there is scope for a number of interesting experiments.

by Philip Watson

THERE is no doubt that the majority of radio enthusiasts are just as keen on gramophone reproduction as they are on the more conventional radio circuits. This is made very plain by the steady stream of letters in our mail which say, in effect, "How can I fit a pickup to such-and-such a set?"

The fellows following this course are no exception, and there have been repeated inquiries as to when our set would reach the stage when it, too, could be used with a pickup.

Since the present circuit lends itself to some simple alterations and interesting experiments along these lines, this is probably as good a time as any to discuss the main points of pickup reproduction. However, we should stress that in any mantel receiver there are severe limitations to the quality of reproduction, such that the results from a pickup can never be anything but rather mediocre.

EXPERIMENTS

However, the objective at the moment is not to achieve immediate and spectacular results, but rather to learn from our experiments. The lessons learned can be applied later to the construction of a more ambitious amplifier.

In addition to purely technical limitations of a mantel set, there is the very interesting psychological aspect that record-playing demands a degree of attentive listening which is seldom given to the radio. The very fact that we take the trouble to select a particular record and to put it on the turntable means that we are prepared to devote all our attention to that item, as distinct from the radio, where the program often provides little more than a pleasant background to other activities.

The upshot of all this is that limitations which pass more or less unnoticed in a small mantel radio become painfully obvious when we try to use the same equipment for the reproduction of records.

LIMITATIONS

Of these limitations by far the most serious are those created by the speaker, the speaker transformer and the baffling arrangements. The "handy" size required for a set of this type is only obtained at the expense of reduced bass response. When this effect is combined with a pickup efficient at the higher frequencies the overall result can be very "thin" unless steps are taken to balance things up a little.

Some improvement can be effected by the deliberate limitation of the high-note response, but a much more satisfactory arrangement is to provide a large, well-baffled speaker as an extension unit. If a better quality transformer can be added, so much the better. Under these conditions the results are quite impressive, in spite of the simple circuit, and we strongly recommend that you fit extension speaker terminals at the same time as you make provision for the pickup.

Admittedly, large speakers are not cheap and there may be many who will hesitate at the idea of the additional outlay. However, the fact must be faced that if you eventually want good quality record reproduction, you must have a good quality speaker and that, once you have it, it will be equally suitable for more elaborate amplifiers which you may want to tackle in the future.

PICKUPS

Before detailing the intended modifications, it may be as well to say something on the subject of pickups in general, for the large variety on the market tends to be confusing, and the results can be very disappointing if the unit is not chosen with a view to the job it is to do.

First of all, what is a pickup required to do? Let's retrace our steps a little.

By this time you have probably

grasped the idea that there are two distinct forms of signal handled by a radio receiver, namely, the radio frequency signals which "carry" the signals we want to hear, and the audio frequency signals, which remain after the radio signals have been separated and removed by the detector and filter systems.

At this stage the signals, although at an audible frequency, are too weak to be of much use and need an amplifier to raise them to the level where they will operate a loudspeaker. In our existing set, this amplifier consists of the 6AR7 as a triode and the 6V6, together with the power supply and the various coupling circuits.

AUDIO SOURCES

Now the point about all this is that the amplifier may be fed with audio signals from sources other than the detector, so that, if our pickup can be made to deliver signal voltages from the pattern engraved on the record, these may be fed to the amplifier and raised to a level where they will operate the speaker. This, then, is the primary function of a pickup, but it is obvious that it must be able to do a better job than the old acoustic sound-box, otherwise the added complexity would not be justified.

The pickup aims at improvement in two directions, firstly decreased weight and reduced record wear and secondly improved reproduction by the elimination of all forms of distortion. While the perfect pickup is no doubt still to come, vast improvements have been made in recent years. It is indeed a far cry from the early six ounce "rock crushers," with a response to three or four thousand cycles, up to the quarter-ounce featherweights of today with a response to 20,000 cycles.

In general, these improvements have only been obtained at the expense of reduced voltage output, so that the first-rate pickup of today requires a much more sensitive amplifier than was customary a few years ago. Thus, we must choose our pickup very carefully when it is intended for use with simple equipment.

BASS COMPENSATION

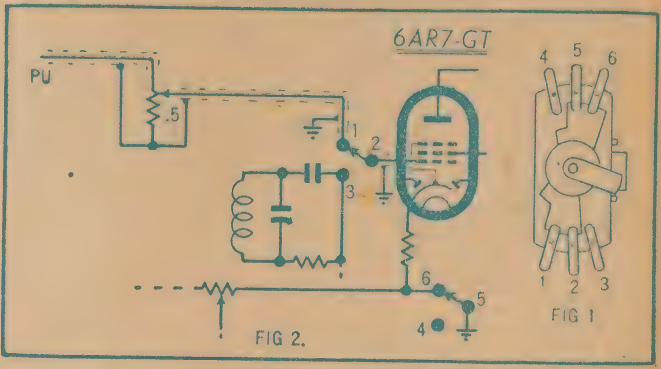
Another factor to be considered is that of bass frequency compensation, the need for which is brought about by the characteristics of the gramophone record itself. In the interest of reasonable playing time it is necessary to severely restrict the amplitude of the bass frequencies when recording and, if the correct balance is to be obtained on playback, the reproducing system must compensate for this by providing an equivalent rise at the bass frequencies.

In the past, makers tried to build this compensation into the design of the pickup but there were disadvantages to this idea, particularly in the case of the magnetic type. Present-day design favors a complete lack of compensation in the pickup, leaving this job entirely to the amplifier. This means that not only must the amplifier provide sufficient gain to handle the low output but it must also have a rising base characteristic to preserve a balanced response.

For this very reason, many experimenters are disappointed with the results from a modern pickup for, when fed into the pickup terminals of an ordinary receiver, the signals will be weak and completely lacking in bass response.

All this no doubt appears rather frightening, and the fellow who merely requires reasonable reproduction of his records with a minimum of equipment may feel inclined to give the idea away in disgust. But so far we have been considering, for the most part, only the magnetic pickup. The other type, the crystal pickup, is much more promising from the beginner's point of view.

This type has always been characterised by a high output and a natural rising characteristic at the low frequency end, features which have always made it popular with simple equipment. While the present trend for lighter weights and improved high frequency response has had its effect on this type as well, the output is still considerably higher than the magnetic equivalent, and it retains the natural bass boost which the magnetic no longer possesses.



Circuit diagram showing connections to the 6AR7-GT for pickup, and a sketch of the switch.

On the other hand it is perhaps only fair to point out that crystal pickups in general do not possess as smooth a response curve as can be obtained with the best magnetic types, although the latest types have been improved considerably over the early models in this respect. Futhermore, they only suffer by comparison with the magnetic type when the remainder of the equipment is of the highest — and most expensive — quality.

TYPICAL PICKUP

Typical of the modern crystal pickup is the Acos GP20 which, in addition to the features already mentioned, has a semi-permanent sapphire stylus and may also be adapted for microgroove records by fitting the correct type of head. All things considered we decided that this was about the best type for the beginner since it would enable him to break into this phase of reproduction much earlier than would otherwise be possible.

If you happen to own an ordinary crystal pickup, use it by all means, although it will be useful only for the conventional 78 rpm records.

So much then for the general consideration, and we come now to the details of how our existing receiver can be modified to take the pickup input. To make this changeover two things need to be done, first the grid of the 6AR7 must be disconnected from the existing components and connected to the pickup and its associated volume control. Secondly the existing volume control must be removed effectively from the cathode circuit of the 6AR7 so that the valve will work with the constant bias supplied by the 300 ohm cathode resistor.

To enable the set to be used either as a radio or amplifier without having to attack it each time with a soldering iron, we arrange for these changes to be made by means of a switch, and this provides an opportunity for us to introduce a type which will be new to many of you, namely the "wafer" type switch.

This type finds many applications in radio, such as selecting coils in dual wave receivers, selecting ranges in meter circuits, or effecting simple changeovers of the type we have in mind at the moment. According to the job to be done, so the size and complexity of the switch varies, ranging from a single wafer with two or three contacts up to multiple wafer designs with each wafer having up to twelve contacts.

The one we have selected is known as a two-pole position type, which means that two independent circuits may each be switched between two other circuits, both operations occurring simultaneously and from the one control knob. In a simple circuit such as this no difficulty will be experienced in following the connections but, in more complicated circuits involving many wafers, the tracing of all the connections may be extremely difficult.

SWITCH CIRCUITS

In order that you may get some idea of how to tackle a switching circuit, we will detail the connections involved in the present job, referring to figure 1 for the switch diagram and figure 2 for the circuit connections, with contact numbers to relate the two.

In figure 1 the contacts 2 and 5 are what is known as moving contacts and 1, 3, 4, and 6 are the fixed contacts. The circuit which is to be switched invariably connects

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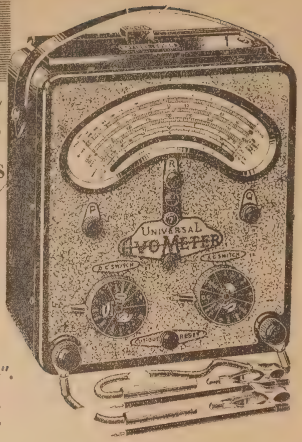

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the moving contact, and the cirits it is to be switched to go to e fixed contacts.

Thus the grid circuit of the 6AR7, nich is the one to be switched, goes contact number 2, and the two rcuits to be selected go to contacts and 3. With the switch in the sition shown in the diagram the oving contact connects with fixed ntact number 1 while contact 3 disconnected, but when the switch moved to the alternative position ntact 3 will be engaged and 1 disnnected.

To accommodate the switch, we e the hole previously devoted to e tone control, but if you prefer to tain this feature you may be able find some other place for it, even it is only a small temporary panel ounted on the back of the chassis. fter all, the set as it stands is still ery much an experimental model nd a few unorthodox fittings are uite permissible.

NPUT CIRCUIT

The pickup input circuit may take e form of a pair of terminals on e back of the chassis or, as in our se, simply a length of shielded ad which may be brought out to ne side of the chassis through the eaker cut-out. The main reason r our choosing this form of conection was to enable us to retain ne two terminals at the rear of the nassis for the extension speaker terinals, but if you care to you may ill a couple of extra holes for the lditional terminals.

A volume control must be proded for the pickup, and this takes ne form of a .5 megohm potentioeter which also provides the load or the pickup. Crystal pickups are ather critical in this regard, and alues lower than that specified will educe the bass compensation charcteristic.

It will probably be most convennt to mount this control somewhere ear the pickup and, in many cases, could be mounted directly on the notor board. If this is not possible, can go on a small panel or bracket n a convenient spot. The lead from ne pickup consists of a very thin lastic wire covered with a shieldng braid, the wire being one conection and the braid the other.

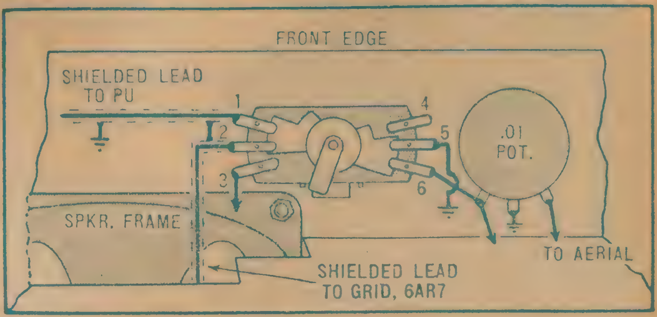
These two connections go to the utside terminals of the volume conrol with the centre wire to the "hot" erminal and the braid to the earth erminal. Looking at the front of ne control the earth terminal is that which is clockwise from the centre erminal and the "hot" lead is antilockwise. It is also a good idea connect the cover of the control the earth terminal.

VOLUME CONTROL

Signals for the amplifier are picked ff between the earth and centre erminals and a pair of terminals longside the control will provide asy connection to the shielded lead rom the set. Once again the shieldng should connect to the earth side, while the inner conductor goes to he centre terminal.

Shielded cable is probably new to nost of you and you may well ask why it is used. The main purpose s to prevent adjacent electrostatic ields from inducing signals in the nain conductor. The most common source of such fields is the AC flowing in various parts of the circuit, which may cause a most unpleasant hum to be heard from the speaker. In addition to the lead from the pickup, that to the grid of the 6AR7 should also be shielded, as it will be lengthened somewhat when taken to the switch.

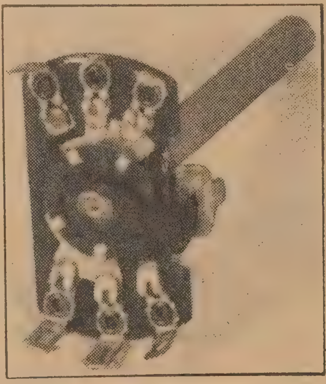
WIRING DIAGRAM FOR PICK-UP



Wiring diagram of the switch connections.

A convenient way to terminate this type of cable is to separate the strands of the braid at a point about an inch or an inch and a half from the end until the opening is large enough to pull the centre wire through it. This now provides two separate leads which may be conveniently connected to the required points. Care should be exercised when using plastic type shielded cable as heat applied to the braid, as when soldering, can easily melt the insulation pull and give rise to internal shorts.

With all this wiring completed you should be ready to play your favorite record but, as we have already mentioned, the reproduction will be limited by the quality of the speaker, baffling, &c. and, for really worthwhile results, irrespective of what type of amplifier is used, a large speaker is essential.



The type of wafer switch we used.

Another defect of the smaller speakers is a very low overall efficiency and, where a reasonable volume may be required, as for example for dancing, they are usually quite inadequate. The difference between a 5" and 12" is no mere academic decimal fraction either, as was amply demonstrated when we connected our regular laboratory 12" test speaker across the voice coil terminals of the 5" and produced such an increase in volume that the latter could not be heard more than about a foot away.

There is nothing complicated about the extension speaker terminals, they are simply connected to the voice coil leads where they terminate on the small insulating strip on the speaker frame. If you are using the terminals on the rear of the chassis a pair of leads may be passed to the underside through the speaker cut-out and then around the inside edge of the chassis.

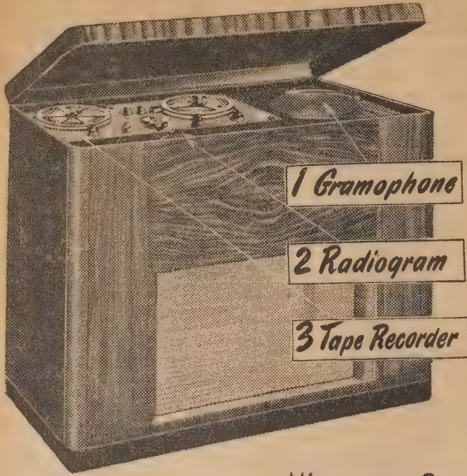
MATCHING

Whenever the subject of extension speakers is raised, there also crops up the old bogy about impedance matching, and no doubt there will be some enquiries as to the advisability of connecting a second speaker across the existing one. Briefly, the effect of an incorrect load is simply to limit the maximum undistorted power output, or in other words distortion will occur at a lower level than it would if the load was correct.

Whether this is important or not depends entirely on how close to maximum the equipment is normally operated. In the case of AC sets there is usually a considerable margin between the domestic listening level and the available maximum and, as a result, there can be considerable mismatch without any noticeable effect on results. Where the maximum output is limited, as in portable and battery sets in general, correct matching is much more important, since there is little or nothing to spare even under ideal conditions.

In the case of our present set there is enough margin to allow the second speaker to be added without worry, particularly as a large efficient speaker will provide a considerable increase in volume anyway.

We mentioned earlier the defects of the speaker transformer, and a



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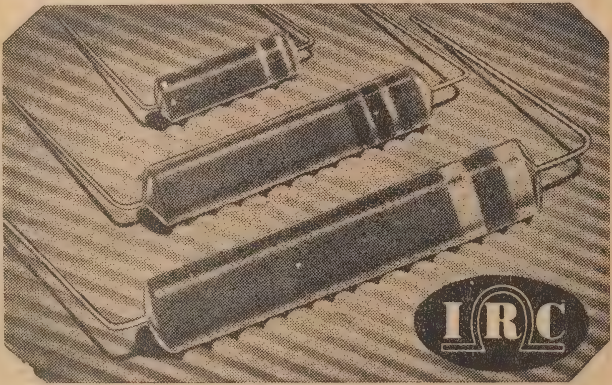

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BRADBURY HOUSE, 55 YORK STREET, SYDNEY. Phone: BX 2508 really good quality one is certainly to be preferred. However these are fairly expensive and many may not care to outlay this much at present and some form of compromise will probably be necessary.

One suggestion is to have a 5000 ohm transformer supplied with the 12" speaker, as this will be a considerable improvement on the 5" type, even if it is not as good as the really high quality ones. If this is then substituted for the existing one on the 5" speaker the improved quality will be available to both speakers.

Having invested in a large speaker it is important that you do it justice by providing the best possible baffling. By calculation it is possible to show that the ideal baffle could be, literally, "as big as the side of a house" and, as this is quite impracticable, obviously some compromise is necessary.

A very popular size is a flat board about three feet square of at least half inch material (timber, plywood, &c.), and with a suitable size hole cut in the centre. If this can be placed across the corner of a room, results will usually be improved still further. In any case, the effect of the baffle will be quite marked, and you will find it an interesting experiment to move the speaker on and off the baffle while it is playing.

FUNCTION OF A BAFFLE

Incidentally there is a lot of popular misconception about the function of a baffle and in order to understand the need for it we must first try to visualise the action of the speaker cone as it produces sound. This action is perhaps best described as that of a piston which compresses the air in front of it on the forward movement and at the same time creates a partial vacuum at the rear. Now, in order to produce effective sound, it is necessary that the compression of air in front of the cone be retained and allowed to radiate, eventually striking the eardrum of the listener.

However with a compression of air on one side of the cone and a partial vacuum on the other the easiest thing for the air to do is simply migrate from the area of compression to the area of vacuum, which it does by moving over the outside edge of the cone from the front to the back. When the cone moves in the opposite direction the reverse happens and the air is shifted from the rear to the front.

This movement does not disturb surrounding air and produces little sound. What is wanted is something to prevent the air in front from reaching the rear of the speaker and vice versa. This then is the purpose of the baffle and its need becomes greater as the frequency gets lower because there is more time for the air to flow back and forth.

Thus the lower the frequency which is to be reproduced the larger must be the baffle and by taking into account the speed of sound it is possible to calculate the size of baffle required for the lowest frequency it is required to reproduce.

The next step is a vented enclosure which not only gives results superior to the simple baffle but, if well made, is more likely to be accepted in the lounge room by the lady of the house. We may have more to say along these lines at a later date. In the meantime you may care to refer to an article on this subject in the April, 1951, issue of Radio and Hobbies.

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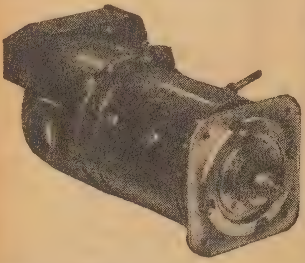

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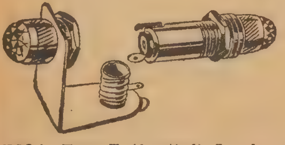

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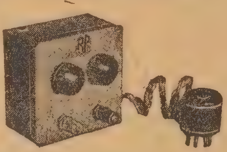

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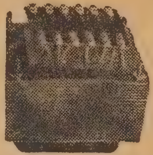

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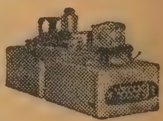

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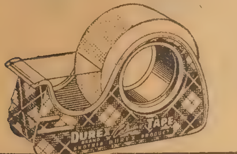

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Transmission Lines

(Continued from Page 33)

many forms that it warrants special attention.

Fig. 6 shows the voltage and current distribution on a line section of this type. The voltage is maximum across the open end where the impedance is high and drops to effectively zero at the short where the impedance is low. The current is maximum through the short-circuited section and drops to a very low value at the open end.

The characteristics of the quarter-wave resonant line shown in Fig. 6 are useful in helping to visualise the properties of the specialised circuits used at elevated frequencies. Cavity and coaxial resonators, as well as waveguides, may be thought of as being evolved by connecting large numbers of quarter-wave open line sections in parallel in various manners to form self-shielded circuits. Such arrangements have much higher "Q" factors than conventional coil-and-condenser circuits because radiation losses are prevented. Fig. 7 illustrates the development of these special circuits from the simple resonator of Fig. 6.

The formation of a "pill-box" cavity resonator is shown in 7 (a). Since the input impedance of the quarter-wave line (shown as a solid line) is very high, a large number of such lines may be connected in parallel without prohibitively lowering the impedance at the terminals.

If enough such elementary resonant sections are connected in this manner to form a solid figure, the result is a resonant structure having a frequency nearly equal to the frequency of each of the line sections forming it. All rf fields are confined within the metal "can."

In a similar manner the coaxial resonator (Fig. 7b) is formed. The open end is usually closed to prevent radiation losses.

A simple concept of the evolution of a waveguide is depicted in Fig. 7c. Here a parallel wire line is supported by "metallic insulators" consisting of quarter-wavelength line sections connected across it.

At the frequency at which these sections are resonant, they have little effect on wave propagation down the line since their shunting impedance is very high. If enough of these supports are added, all fields are confined within the guide.

Ultrasonic Surgery

(Continued from Page 7)

water, fits tightly by means of a rubber gasket so that none escapes.

A piezo-electrical crystal is then employed to project a thin beam of ultra-sound through the skull. A microphone on the other side picks up the beam, which, after amplification, is used to modulate a light source. The intensity of this light source is proportional to the "transparency" of the skull and contents, at the place where the beam traverses it. If the piezo-crystal and the pick-up microphone are now caused to "scan" the skull in the same way is a television image is scanned, a complete picture of the brain can be obtained.

It is claimed that the process is absolutely harmless, and enables the diagnosis of brain tumors and their location.

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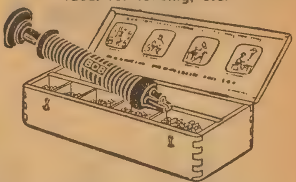

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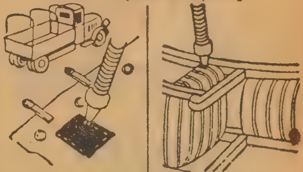

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A COURSE IN TELEVISION

PART 29—THE COMPLETE RECEIVER

With last month's instalment on power-supply design, the stage-by-stage analysis of television receiver design is now almost complete. Before proceeding to study a few specialised aspects of the subject, it may be wise to pause and take another look at the complete receiver.

THE very first article in the series —May, 1949 — carried the block schematic shown here as figure 1. Its purpose then was to show the reader the aspects and stages which had to be studied. Now, more than two years later, you can cast your mind back and recall the progress which has since been made.

Various specialised aspects of the subject remain to be studied, like the sound channel, intercarrier reception, aerial systems, projection receivers, large-screen television, color television, and so on — to mention just a few.

Before proceeding, however, to these more specialised articles, it may be helpful to revise and correlate all the foregoing material by discussing the ordinary television set, as found in British or American homes.

In the first place, the aerial system, which we will discuss in detail later, bears no relationship to the familiar "piece of wire around the picture rail." To obtain strong signals at the high carrier frequencies which all modern systems use, it is essential to employ partially resonant and often directional aerial arrays.

The usual television aerial is made up from metal rods cut to a specific length and attached in a pre-determined fashion to a supporting boom and mast.

The mast is anchored to a chimney or other high prominence on the roof and the signal fed down to the receiver by means of a special RF transmission line. The type of line is important, as also is its connection to the aerial array and to the receiver terminals.

COMMERCIAL AERIALS

While the construction and installation of an aerial and feed system is not beyond the skill of any handyman, it is sufficiently a problem to support a flourishing business in both England and the US to supply special TV aerials. Plenty of servicemen, too, are kept busy adjusting the aerials for best results on weak stations, or eliminating double images caused by signal reflections from large buildings or local hills.

The nature of the actual signal received from a television station was studied in detail in the issues for August, September and October, 1949.

The generation of the initial video signal was explained, then the imposition of blanking periods between lines and frames and the addition of timing pulses. The reader was shown also the significance of positive and negative modulation and of vestigial sideband transmission.

Having taken in this essential information, it then remained to study receiver design in greater detail.

In the RF, mixer and oscillator stages, it was shown, miniature high-slope valves are invariably employed. These feature low interelectrode capacitance, short internal leads and the best practical performance at the relatively high carrier frequencies which are used.

In England, the television stations operate on the 40-60 Mc. region, while there are two distinct television bands in the US. The "low" band runs from 54 to 88 Mc., while the "high" band runs from 174-216 Mc. Australian stations will operate in the 200 Mc. region, so that valve and circuit problems will closely follow those encountered on the US "high" band.

The tuning system required at 200-odd Mc. are naturally quite different from those used in broadcast receivers, the variable condenser giving place to variometer or slug tuning, sliding contacts on the coils, moving vanes and a variety of other devices. The whole subject of "front end" design was covered in the issues from December, '49 to March, '50, inclusive.

TWO FREQUENCIES

From the plate circuit of the mixer, two distinct frequency components are normally available, one representing the picture signal and the other, a few Kc. removed, being the frequency modulated sound signal. Although open to considerable variation, the usual plan in the US at least is to place the picture signal IF on about 25 Mc. and the sound signal IF on about 21 Mc.

Thereafter, the sound channel follows through a number of separate IF and/or limiter stages at 21 Mc., thence into a discriminator of one type or another for demodulation. The audio system, which follows, can be as simple or elaborate as necessary, to conform with the general design of the set.

More will be said later about the sound channel and about recent developments in FM technique, but, in the meantime, readers can refer back to the special FM series which appeared immediately prior to the television course. Attention is drawn especially to the issues from September to December, 1948.

RESPONSE CURVE

The design of the vision IF channel on 26 Mc. poses several major problems, notably the extremely wide passband characteristic and the special shape of the response curve made necessary by the vestigial sideband type of transmission. This latter has been adopted as standard in America and Australia, and is also being employed in all the new transmitters being installed in England by the BBC.

Two complete instalments for April and May, 1950, were devoted to the study of IF amplifier design.

From June to October, 1950, the series took in video detectors and video amplifiers, special emphasis being placed on the need for extremely wide frequency response, extending from a few cycles per second to something like 4 Mc.

It was shown that attention must also be paid, in these video circuits, to the "DC component" of the signal, which tends to preserve the original degree of illumination intended by the producer of the show. The DC component must either be preserved throughout the video

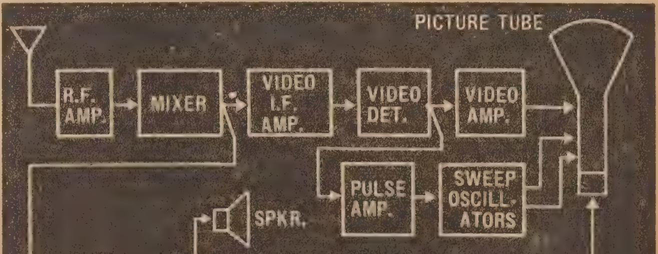

Figure 1. A typical receiver shown in block schematic form. All stages have been studied in detail except the sound channel.

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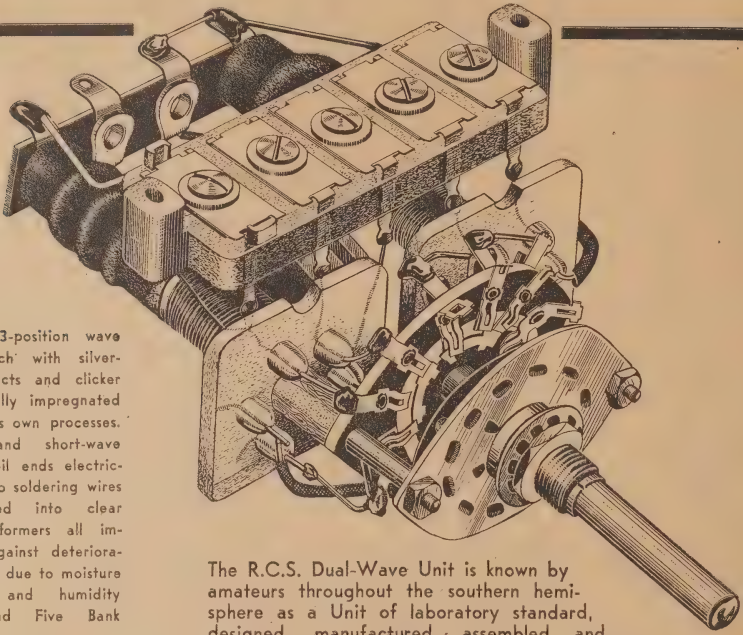

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channel or restored artificially just prior to the picture tube by a special "DC restorer" stage.

In the issues from November, 1950, to March, 1951, the part played by the scanning circuits was discussed in detail. It was shown how the timing signals were extracted from the composite video signal, then separated into the individual line and frame pulses.

Sweep oscillators were discussed and the way they are triggered into synchronous operation by the timing pulses. The reader was shown how these sweep voltages were then amplified and applied to deflection coils around the neck of the picture tube, causing the beam to be deflected in the appropriate scanning pattern.

NEW TERMS

The principle of scanning and the operation of cathode-ray tubes had already been explained early in the series—June and July, 1949.

The three most recent issues—July, August and September, 1951—have covered power supply systems in relation to heater, HT and EHT requirements.

It now remains to pick up a few loose ends on the widely differing subjects of terminology and receiver controls.

The complete receiver will normally have an impressive array of controls, some for operation from the front panel and others tucked inside the cabinet for pre-setting at the factory or by the installation mechanic. Perhaps the simplest method of presentation is to list all likely controls, with appropriate comments.

OFF-ON SWITCH: An obvious function, the position and type of switch varying with the design.

VOLUME CONTROL: Operates on sound channel in the ordinary way.

TONE CONTROL: An optional but conventional panel control.

STATION SELECTOR: A panel control which appears only on sets intended to receive more than one station. It may be a dial mechanism where continuous inductive tuning is used, or it may be a selector switch or a system of push-buttons.

FINE TUNING: A panel control which is normally fitted to receivers employing fixed tuning or channel switching. The fine control is intended to correct for oscillator drift and give accurate tuning.

SOUND SIGNAL

Normal procedure is to set the control for best reception of the FM sound signal, the process being exactly the same as for a conventional FM sound receiver. When the sound signal is properly in tune, the picture signal should automatically be correctly placed in the video IF pass band.

BRILLIANCE: This also is a panel control which corresponds to the familiar "intensity" control on a cathode ray oscilloscope. It varies the effective bias on the picture tube and, therefore, controls the intensity of the scanning beam. It should never be advanced unless the scanning circuits are in operation to produce the scanning pattern or "raster." A stationary spot on the screen will very soon burn the fluorescent material.

TEST PATTERN FOR TV RECEIVERS

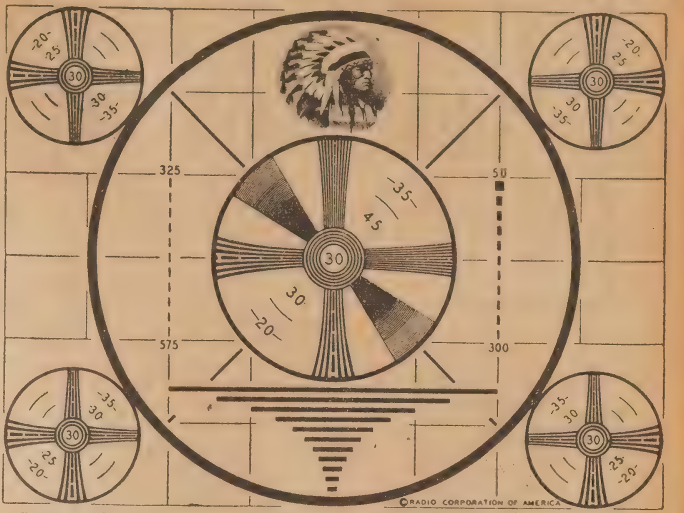

Figure 2. The test pattern supplied by the RCA "monoscope" tube. Station patterns are somewhat similar and greatly simplify image adjustment.

Advancing the control under normal conditions will flood the screen with light and increase the apparent brightness of a picture. It does not necessarily improve the clarity or contrast, because the dark areas of the picture are made bright along with the light areas.

The main use of the control, in practice, is to compensate for variations in "ambient" light — the external light falling on the face of the tube. Under conditions where the ambient lighting is high, the brilliance control will need to be advanced further than when the picture is viewed in semi-darkness.

TOO MUCH LIGHT

Even allowing for the effect of the brilliance control, there is a practical limit to the permissible ambient light beyond which it is difficult to obtain a satisfactory picture. Special filters and "black face" tubes are being developed which give more tolerance in this respect than conventional white face tubes.

CONTRAST CONTROL: This is equivalent to the gain control of an ordinary receiver and it may function in any suitable fashion to vary the gain between the aerial input and the intensity grid of the picture tube. It determines the strength of signal at the picture tube grid, the degree of electron beam modulation and, therefore, the amount of contrast.

With negative modulation, the signal peaks produce the black areas in the image and insufficient signal results in the lack of dark tones with useable degrees of brilliance. With positive modulation the result is an initial lack of highlights. If the brilliance control is advanced in an effort to produce a bright picture, the black areas become grey.

It follows that an optium balance must be struck between the setting of the two controls, depending on ambient light, viewing distance and so on. Too much or too little of either control will exaggerate highlights or shadows, as the case may be and cause further deterioration of picture quality by defocusing the spot.

Excessive signal input and contrast may cause random triggering of the time base circuits and "tear" the picture. In extreme cases, overload of the video IF or amplifier stages may produce severe distortion, even leading to tone reversals and the production of a "negative" picture.

In a receiver designed for multichannel reception the contrast control will normally be on the panel. Where one station only is catered for, the contrast control can well be mounted at the rear and preset at the time of installation. Only the brilliance control need then be adjusted.

FOCUS CONTROL: As in the familiar CRO, the purpose of the focus control is to adjust the electrical focus of the cathode ray beam. With well-designed power supplies and magnetic focus, the control can be located behind the receiver and preset, needing very little attention thereafter.

FOCUS ADJUSTMENTS

With electrostatic focus, the variables in the circuit are more serious, so that more frequent adjustment of the control is required. In this case it would most likely be mounted on the front panel.

VERTICAL HOLD, HORIZONTAL HOLD: These serve the same purpose as the "Synch." and "fine frequency" controls in a CRO, serving to synchronise the receiver time base circuits with the pulses from the transmitter. When the frame hold is correctly adjusted, the image will roll or jump in a vertical direction until the line hold is properly set—and vice versa. Correct setting of both controls produces a steady picture free from "tearing" effects, odd lines at the top or blank bars on the screen.

In a well-designed receiver, the "hold" controls should not require more than occasional attention and will normally be mounted at the rear. Poorly designed timing circuits may drift and require frequent

(Continued on Page 95)

Let's Buy An Argument

To a mean and argumentative type, there are two supreme joys in life. The first and obvious one is the opportunity of saying, "I told you so." The second is the satisfaction of not saying it when the other party knows you could!

by W. N. Williams

THE first matter is of minor consequence now to most of us but very important indeed to the person concerned. Our friend R.S. from Perth obviously did not see my reference in these columns, a few months back, to the lamentable confusion which some text books still breed in relation to current flow.

Instead of coming out in the open and admitting that the early and arbitrary definition of current flow is wrong, they still try to reconcile it with the electron principle. "The electrons flow this way," they say, "but the current flows back the other way."

Stuff and nonsense! Current flow is essentially and only the movement of electrons and if the electrons flow from negative to positive, then current flows that way too! If the traditional idea of current flow has to be mentioned at all to support equally traditional magnetic diagrams, then the student should be advised openly of the falsehood and his mind set at rest.

The bewilderment of our student friend, whose letter we quote opposite, is just another example of this technical dishonesty.

"I told you so."

Another point raised recently in these columns was the distortion likely to be introduced by the aural sense and its possible ability to mask residual distortion in a musical signal. My ideas did not meet with universal approval, the "opposition" contending that such non-linearity was apparent only at high sound intensity.

To counter this, I pointed out that the average person could detect beat notes between pure sine waves at quite low sound intensities, indicating a serious non-linearity somewhere in the overall link between the air column and the brain.

I was therefore interested to read an article in the latest issue of our esteemed contemporary Wireless World, in which some of these physiological aspects were examined. To quote:—

"It is often said glibly that the ear is the final criterion, but this is only a half truth. Much is known about the mechanism of the ear itself: That the electrical potentials generated in the cochlea faithfully reproduce the acoustic wave-form, but that these potentials are applied to nerve fibres which constitute individual bottlenecks to the extent that they can transmit only "spikes" or pulses of their own characteristic wave-form at a repetition rate with a maximum probably no higher than 4000 or 5000 per second.

REAL PUZZLE

"Some help in recognising high frequencies would seem to be conferred by the fact that the region of stimulus in the cochlea is dependent on frequency, but any orderly arrangement at this point is offset by the apparently random connection and mixing of the nerve fibres connecting the cochlea to the brain.

"How the brain sorts out this jumble of coded signals and finally conveys the consciousness of, say, a pure sine wave of 1000 c/s at a certain loudness level is still one of those mysteries which the physiologists have yet to solve, but there seems little doubt that the faculty of interpreting this pattern is one which we acquire as the result of a long sequence of experiences beginning at birth.

"When we speak of 'the ear' we generally mean the whole process of auditory perception which includes the brain and one's past history of experience and training.

"It is important to recognise that quality which satisfies now may prove to be intolerable in five years' time; conversely, blemishes in reproduction which are noticed at first hearing, if they are not corrected at once, may be assimilated into the background of experience and tolerated by habit.

"The ear, then, is not necessarily the final criterion; it is too easily conditioned to the familiar and becomes alert only to unaccustomed elements—true or false—in the sound. Direct comparison with the original—is the only firm basis for the development of a critical faculty."

Well, so much for that. Perhaps I had better not say, "I told you so" this time because the ground for it isn't so certain. But I still think it's interesting.

Equally interesting is another par. which I came across in an old copy of the same journal. Before you read on, I suggest you peruse and inwardly digest the quotation in the panel, in which a writer expands on the ideas of Dr. Malcolm Sargent, the famous conductor.

And now for a few original comments on another subject altogether.

During the past few months, the whole business of tape recording and playback has assumed the proportions of a giant technical bubble. Every second person I meet seems to be in the process of buying or building or wanting to build a recorder, under the impression in many cases that all other systems are poor and obsolete by comparison.

The bubble might easily burst, unless a little commonsense prevails, leaving those who have spent time and money on it with the conviction that they have been sold a proverbial "pup."

This might sound a rather drastic statement but I don't think it's without justification. Tape and tape machines have their "cons" as well as their "pros."

A SOUND PRINCIPLE

The basic idea of magnetic tape recording is good and I've said so on more than one occasion. Its flexibility as a medium is unrivalled and it avoids the nasty mechanical linkages of the disc system, with which it is so frequently held in contrast.

In fact, I would go further and suggest that, taken all round and carried to its logical limit, magnetic tape recording represents the most flexible, the most foolproof and the most accurate system yet devised for sound recording.

Machines have been built which fully exploit the possibilities of tape and I have heard demonstrations on them which have been very difficult to fault in any way. It has become commonplace to use tape for "master" recordings, dubbing later on to discs for general release.

But the outstanding results which are obtainable from high quality professional machines have, unfortunately, fostered the general idea that everything on tape must be equally good — or nearly so! Being all-electronic, that somehow makes the response level, the distortion low and the noise negligible. Therefore you get these "good" results with a simple portable recorder, a hand microphone and a 5-inch speaker!

So the impression has grown—a combination of truth, half-truth, sales talk and wishful thinking!

But let's examine the proposition objectively and, if I seem to be unduly critical, please remember that I'm not at all against tape. I like it and I personally could find a variety of uses for a recorder right now!

"MECHANICAL" FEATURES

In the first place, tape recording is NOT entirely electronic in character, although it is much nearer that ideal than the disc system, with its involved mechanical link between the initial recording current and the ultimate playback voltage.

Not counting the machinery necessary to transport the tape, the performance is limited initially by the physical attributes of the particles which comprise the magnetic coating. Their size, their shape and density, their magnetic properties, their ease of manufacture and so on, are all the product of compromise.

So also is the gap dimension in the magnetic head and the speed of travel of the tape. These purely physical and mechanical dimensions limit the ultimate performance just as surely as do the dimensions of the playback stylus and the recording groove.

Knowing the relevant figures, it is possible, indeed, to predict very closely the performance of any given tape machine.

For example, at the present state of the art (to use a classic phrase) the maximum frequency response from a tape reproducer cannot be substantially higher in terms of Kc/sec. than is the tape speed in terms of inches/sec. Thus a 3-¾in machine can have an absolute top frequency limit of about 4 Kc and so on.

Most of the portable tape machines around the place at the moment operate at the popular standard of 7½ inches per second and their absolute frequency limit by this rule of thumb is about 7½ Kc.

That the figure is justified, I have little doubt. Quite recently, a very good engineer friend managed, b dint of much adjustment and compensation, to extract a useful 8 K from such a machine but nary cycle more!

If the usual portable tape machin could do even as well as that, on could hardly grumble because really flat, noiseless and distortion free output to 8 Kc can sound might fine. I'm afraid, however, that man who expect as much from a simpl tape recorder will be doomed t disappointment.

The best portable recorder I hav yet heard has a response which dropping like a plummet at 6 K while the bass end is doing likewis at 60 cps.

I freely admit that the machin is excellent for speech and good, to for recording "casual" musical item The output is free from noise ar obvious distortion and the resu quite pleasant listening. Howeve it's plain silly to suggest that machine giving nothing outside t 60-6000 limit represents high fidelit And that, mind you, is for the mac

TO HEAR OR NOT TO HEAR . . .

"At a recent meeting of the Royal Society of Arts, Sir Ernest Fisk announced that E.M.I. had been successful in recording frequencies up to 20,000 c/s on wax discs. In view of the fact that even the lissom ears of the human young can respond to nothing above obout 16,000 c/s whilst those of aged dodderers like myself have normally a cut-off in the neighborhood of 10,000-12,000 c/s, your comment on this statement might be a ribald, 'So what?'

"But when Sir Malcolm Sargent and others who know both their musical and their acoustic onions maintain, as maintain they did, that even higher frequencies may have to be recorded in order to obtain complete realism in reproduction, you begin to do some thinking.

"At first blast the idea seems utter nonsense: how can what we hear be affected by the presence or absence of frequencies that we can't hear? And then something at the back of your mind whispers that f1-f2-f3; in other words, two supersonic frequencies may produce an audible beat frequency.

"It seems quite possible that when an orchestra is in action the supersonic upper harmonics of certain instruments do produce such beats. If they are absent from an electro-mechanical reproduction, it doesn't sound quite real.

"If the original supersonic frequencies are, say, 19,000 and 21,000 c/s the beat will be at the audible frequency of 2000 c/s. Assuming that there is such a beat and that I record and reproduce up to, perhaps, 6000 c/s,, why should not the beat frequency of 2000 c/s be adequately brought out, even though the generating frequencies are removed by the cut-off at 6000 c/s?

"The answer is that non-linearity is required somewhere in the system to produce the beats. If the recording microphones, amplifiers and cutting heads are free from non-linearity distortion the beat frequencies will not be generated as such in the record, nor will they be present in the reproducing equipment if it is similarly free from 'amplitude distortion.'

"Not until the original supersonic frequencies reach the non-linear device known as the ear will the audible beat frequency emerge.

"So if you cut off the 16kc/s in recording you must do your mixing and introduce some non-linearity before or in the cutter head if you want to record those beats. Which poses the question: If one records only the whole gamut of audible sounds how much non-linearity distortion should be introduced for realistic reproduction?" ("Diallist").

ANOTHER VICTIM!

I am learning the fundamentals of radio and, after reading a book on the subject, I have struck several queries.

First of all, I am confused by the meaning of the word "current." In the book it states that Current is the quantity of electrons flowing in a circuit and that electrons flow in the opposite direction to the current. (i.e. current from positive to negative and electrons vice versa).

How is it that electrons flow in the opposite direction to the current when, in effect, they are the same thing?

Is there such a thing as positive electricity? If so can a battery drive electrons from the positive terminal to the negative one? How can the electrons flow from plus to minus, which is just the reverse to the law? (R. S. East Claremont, Perth, W.A.).

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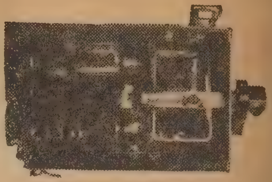

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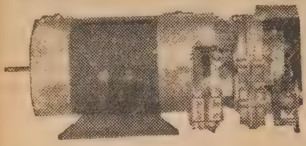

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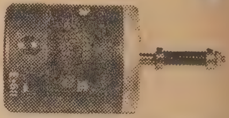

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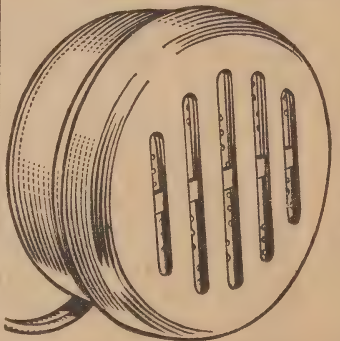

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ine which I have rated as the "best"—at least of those which I personally have checked.

But only last week, I had a good look at another machine operating at 7½ inches per second and its response on speech was so "woolly" that it obviously must have been well on the way out at 4 kc—and there was no bass either!

It should have been possible, theoretically, to obtain that degree of fidelity "for speech only" at a tape speed of 3¾ inches/sec., representing a two-to-one saving in the cost of tape. The fact that the slower speed was not chosen and that only mediocre results were obtained from the higher speed would seemingly emphasise the difficulties of achieving theoretical limit figures in a simple machine.

HIGHER SPEED

On present indications, really high quality reproduction can only be expected from a 15 inch/second machine and then only after very careful equalisation at both ends of the spectrum.

And speaking of equalisation, it seems that little progress has been made toward adopting frequency standards to which machines should ideally conform. For the most part, the individual manufacturers proceed on the basis that each tape will be played back on the machine which made it and the end result is the important consideration.

As I said, that can only be regarded as an expedient and it is highly desirable that standardisation be introduced now, before the market is flooded with "non-standard" machines.

The very nature of tape recording and playback is such that it produces a peak output at one frequency with a downward slope in either direction. The position of the peak and the shape of the curve depends, in turn, on the physical constants of the system.

To offset the natural peak, it is customary to apply some equalisation during recording and further equalisation for playback, the end result being, we hope, rather more level. The points in question are just where the peaks should be placed and how much equalisation should be applied during the respective processes?

OBJECTIONS

Until suitable standards are agreed upon, it will be a matter of accident if a tape recorded on one type of machine plays well on another.

Challenged on this point, one local engineer objected immediately on the grounds that the heads would have to be standardised first, because they virtually controlled the final result with a given tape and tape speed. Exactly!

I am well aware that magnetic heads are hard to make and hard to keep uniform — but no harder, I imagine, than a box-full of 1-mil stylii. It's largely a matter of facilities and general "know-how."

Standardisation isn't an urgent problem for present activities but it ought to be tackled now if the tape industry has any ideas of building up an entertainment market for itself. But perhaps this is too much to hope for. Perhaps the potentialities of tape may for ever be confined for you and I, to office letters—or somebody's sister singing a song!

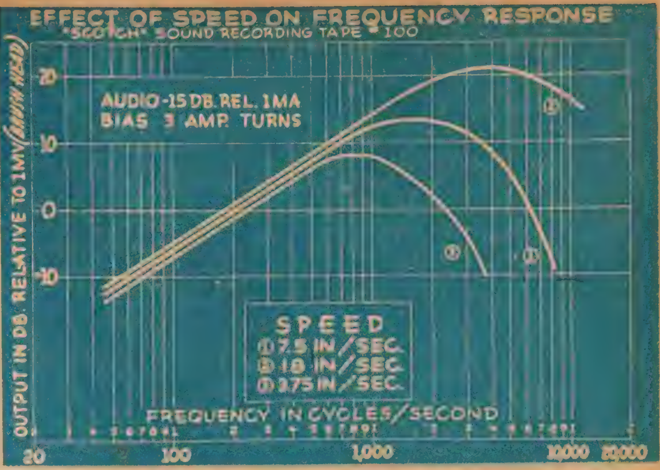
And we've got something to learn yet about spooling and drive problems. I have yet to see a tape recorder about which I could be completely happy on this score — I speak still of the portable machines which the man-in-the-street is likely to afford.

There is a common tendency, after a while, for the take-up spool to lose drive on full diameter. The rewind tension is often too low also, so that the reel spills over. The reels themselves buckle and drag the tape out of line. The tape seems to vary somewhat in thickness or surface adhesion, leading to more uneven winding.

And strangely enough, the machine which seemed best to my mind to solve all these problems by rigid mounting of motors and pulleys, suffered dreadfully from spindle flutter

After all this, the reader migh well conclude that tape recorders ar a miserable failure but that's not th point at all. Equally caustic comments could be made about the shortcomings of gramophone motors an pickups, with their rumble, wo limited response, needle chatter an so on. Nevertheless, fully aware o their shortcomings, readers use the by the tens of thousands and gai much pleasure therefrom.

The same open-minded approac must be preserved in relation to tap It is simply an excellent and relatively new medium having its ow special facilities and limitations. Th wise man will carefully consider bot —not go off the deep end because it something new.



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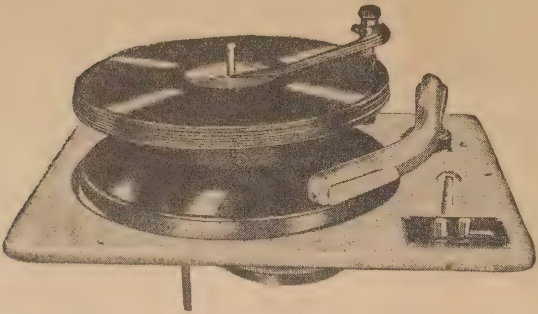

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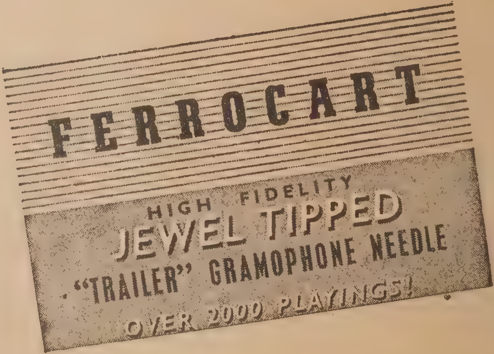

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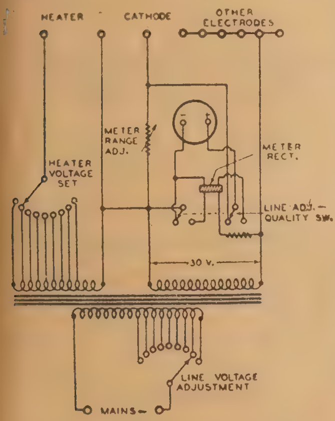
FROM THE SERVICEMAN WHO TELLS

Next in line for discussion in our test equipment series is the valve tester, and in this article I have tried to present all the important factors to be considered before you buy one. This month's fault, which is also featured, emphasises the need for care in selecting replacement components.

OUR approach to the valve tester is rather different from that of other instruments for this is one that has a definite customer appeal—an appeal which is well worthwhile exploiting. For some strange reason, this is one instrument which even the dumbest customer understands—or thinks he understands—just as the valve is the first component he suspects as soon as his set fails.

Consequently you will find you have a steady stream of customers requesting that you "test these valves, please," and you don't have to be super intelligent to realise that each one represents a potential sale.



This circuit shows the basic requirements of an emission tester. Though fundamentally simple it becomes exceedingly complex when provision is made to accommodate all types of valves.

Some shops provide this testing service free, while others make a small charge, the wisdom of which is open to some debate.

As I see it, you can well afford the time spent on testing the valves if it encourages a customer, with a radio problem, to enter your shop. The fact that he has a problem makes it hard for you to lose for, if he has one or two faulty valves, you should have little difficulty in selling him replacements. If all his valves are good, on the other hand there must be something wrong with the set itself — or in other words, another service job. All of which adds up to a strong case for a free valve testing service and preferably a "counter" type valve tester.

By a counter type tester I mean one which is suitable for use on the sales counter and which will spend most of its time there rather than in the workshop. It may not seem very important, but it makes a much better impression on the customer if the test can be conducted in his presence. Furthermore, you free yourself from the risk of the occasional "nasty type" who will accuse you of switching valves if you take them out of his sight.

While that will be your viewpoint as a salesman, you have also to consider the matter from the technician's angle. (You'll get used to this dual role business after a while!) Now you want the tester on your work-bench and it certainly is inconvenient and time consuming to have to trot out into the shop each time you want to test a valve.

TWO JOBS

While there is no doubt that the ideal arrangement is a tester for both the counter and the workshop (and a business big enough to justify them) this is hardly the situation for the chap just setting up, and the inconvenience of using one instrument for two jobs may have to be tolerated for a time at least.

Anyway, what I am really trying to get at is that there are two quite different jobs to be done by this instrument and, although most types will serve reasonably well in either capacity, there are certain features which are more important in one case than the other. Perhaps the best thing I can do is to summarise the requirements of each and leave you to make your own decision.

First the counter type, where the emphasis is on simplicity, both of operation and indication. It is as well to keep in mind that you may not always be a one-man organisation. In fact, the sooner you can employ someone to handle some of the routine work the better, and the testing of customers' valves is something which can well be left to someone whose time is less valuable than yours.

For this reason a counter tester should be simple and quick to operate and, at the same time, give the customer a clear and positive indication of the worth of the valve on a simple scale which he can understand.

SIMPLE TESTER

Such an instrument must also be a valve tester purely and simply for, if it is combined with an elaborate multimeter, the latter will be largely wasted, while the difference in first cost will be considerable.

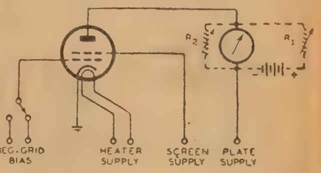
All this suggests the simplest possible emission tester, with provision for shorts test, and a clear easy-to-read meter, preferably one of the larger type, with scale marked "GOOD-?-BAD." Even the once popular percentage figures are best avoided, since they really do not give any useful information and, in fact, can be actually misleading.

For the workshop we can select a rather more complex instrument, but it is as well to keep in mind that there is difference in the requirements of a service shop and those of a laboratory, and too complex a device may be more of a liability than an asset.

One test which every instrument should provide is that for shorts between elements, not only because their presence will affect the operation of the valve, but also because they can damage the tester when the subsequent "goodness" tests are made. It is for this reason that the shorts test should always be made before any other, and further tests should be abandoned if a short shows.

It is also useful if the shorting elements can be identified, as this is helpful in confirming that observed symptoms are, in fact, due to the valve short. Also, examination of a set will often show that shorts between certain elements can be tolerated, and the set will continue to operate even though the valve is technically bad. This feature is available in some types and not in others. All else being equal, it is worth looking for.

Just what form the main test of the valve should take has been the subject of many arguments, some claiming that the emission test is adequate, while others maintain that nothing less than a mutual conductance test is sufficient.



This shows the principle of the grid shift type of mutual conductance test. Like the emission test it is simple only so long as one type of valve only is considered.

The emission test, as its name implies, measures the ability of the cathode to emit electrons, and indicates when this emission has fallen below the figure necessary for satisfactory operation of the valve. Such a test is logical, inasmuch as the emission is the most likely single factors to cause the failure of a valve.

EMISSION TEST

Indeed, it is only a matter of time before such a failure is inevitable in any valve. In just the same way as the active material is used up inside a dry battery, which must then be discarded, so the active material on a cathode is used up until it, too, must be discarded. Any test which indi-

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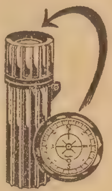

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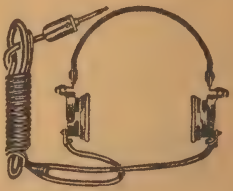

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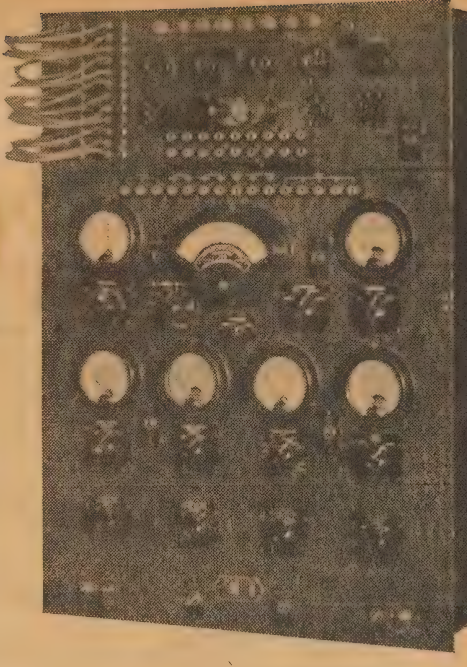


This most comprehensive American valve tester is capable of applying almost any test to any valve. While ideal for the laboratory it is just what the serviceman should avoid as the setting up time for each valve would be far t[illegible] long.

* * *

cates when this condition has been reached may be regarded as effectively indicating the "end-of-life" point.

Basically the emission test is quite simple. Rated voltage is applied to the filament or heater and, after the short test has been made, a voltage of about 30 is applied between the cathode and the element nearest the cathode. This is usually the signal grid, except in the case of simple diodes, when the plate is used.

Inserted in series with the selected element is a milliammeter, which measures the current flow through the valve and which is, of course, governed by the emission. A calibrated variable shunt across the meter enables the sensitivity to be varied to suit the valve type being tested, so that a good valve will always read in the same part of the scale.

PERCENTAGES MISLEAD

When interpreting an emission test one very important fact must be kept in mind. The amount of emission is of little significance once the critical minimum has been exceeded. An increase above this point has practically no effect on performance, the valve merely requiring a sufficient number of electrons to do a certain job, after which the characteristics of the elements, their number, spacing, &c., dictate the performance.

This is the reason I said earlier that percentage figures could be misleading, for it implies that a valve with 90 pc emission will give superior results to one with only 70 pc, whereas they would probably both give identical performance. Furthermore, they would continue to give this performance until they reached the end-of-life point (usually shown as 50 pc), after which the performance would drop so rapidly that there would be little point in assigning it a figure of merit. Much better to simply grade it as "bad."

Thus the emission test, if intelligently applied, tells us when a valve is worn out. Unfortunately, although this is the common fault, it is not the only one. Apart from shorts, which should already have been checked, there are such defects as open circuit elements, sagging grid wires, cathode hot spots and gas, all of which will detract from the performance even though the emission test says OK.

Although this is the strongest argument in favor of the mutual conductance test it must be realised that these faults represent only a fraction of the total and the large majority of faulty valves can be picked with an emission tester.

CHEAPER TYPE

The mutual conductance test is undoubtedly more comprehensive and, in its ideal form, tests the valve under conditions closely resembling those of actual performance. This entails the application of normal operating voltages to all the elements of the valve and noting the effect of varying the grid voltage over a prescribed range. The effect on the plate current is then taken as a measure of the mutual conductance and, providing the correct voltages have been applied, will give an extremely accurate indication of the valve's worth.

It is quite obvious that the emission tester is the simpler of the two, both in the design of the instrument and operation and, as a general rule, this means lower first cost as well as quicker and easier operation. Both these factors are important, the last one particularly so, for it is all too easy to find oneself saddled with a laboratory-type monster which will increase the testing time per valve out of all proportion to the requirments of a service shop.

Personally I am inclined to favor a good emission tester as being the best compromise between cost, simplicity of operation, and general testing efficiency. Note that I say a good tester, and I'm afraid this means that home construction is out.

This is one occasion when we must bow to the superior knowledge and facilities of the commercial manufacturer, pay up and look pleasant. Admittedly the basic principle of the emission tester is delightfully simple, but anyone who has ever contemplated building a tester has quickly realised that this is no guarantee of a simple instrument.

The real snag is that we have to cope with an almost unlimited variety of valves—European, American and Australian—with their differing bases, pin connections and operating conditions. A tester which will take care of all these, plus possible future variations, and not have more than a reasonable number of knobs, calls for very careful design as well as many special components, particularly switches. Many of these are not normally available to the home constructor.

CALIBRATION

Even assuming that you overcome these problems and build your tester, there remains the very real problem of calibration. There is no easy way to calibrate an emission tester, for it can only be done by testing a number of valves, both good and bad, of each type, and the average fellow just does not have these available.

I know that some enthusiasts have made their own, but they are generally confined to simple devices suitable only for the more popular types of valves and which are calibrated by long experience. Valuable as they may be to the experimenter, they are virtually useless for the professional serviceman.

This brings us to the points to be looked for in a commercial tester, and one of the best features which any tester can have is flexibility of switching. If this is carried to a logical degree it must be possible to select any pair of pins for the application of filament voltage and any electrode plus the cathode for the application of test voltage. When this is possible it becomes comparatively easy to accommodate new valve types as they appear, for altered pin connections present no real problems and even a new base only requires one simple adaptor.

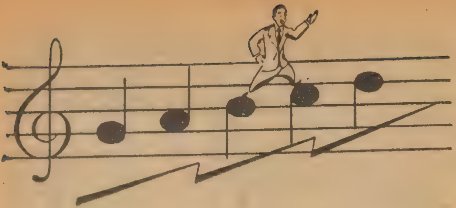
Incidentally most makers issue supplementary data at frequent intervals giving the settings required for new types.

FILAMENT VOLTAGES

A really flexible design will only require one socket of each type and one should be wary of a unit which has a number of sockets of the same type to handle different base connections, for it is extremely likely that a new valve type will find them wanting. In this regard be particularly careful of secondhand types which may be available at what appears to be a very attractive price, as they are usually obsolete by present day standards.

An adequate range of filament voltages is very desirable and should preferably extend to the 117 volt mark for, although these values are not normally used in Australian sets, it is surprising how often one is required to deal with an imported AC/DC job having all kinds of odd valve types.

Whether to buy a combined multimeter or a straight out valve tester



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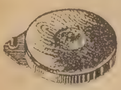

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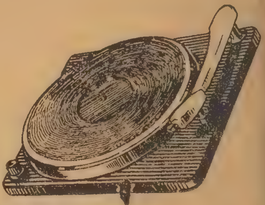

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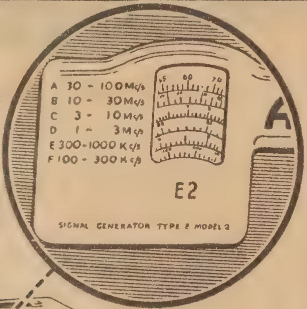

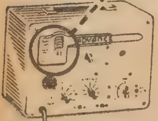

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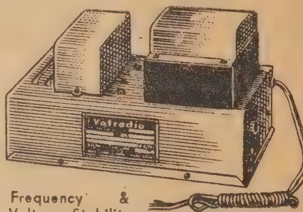

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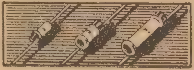

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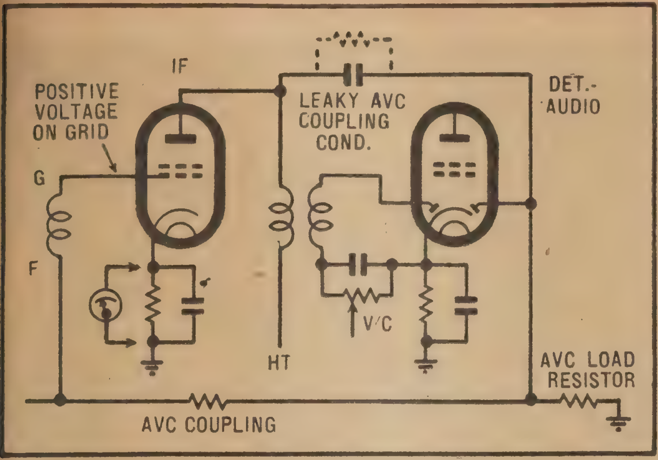
is another question which must be settled. The straight valve tester will save you initial outlay and, providing you can get the type you want, this saving may be worth while.

However, it may so happen that the type you favor is only available as a combined instrument and you may feel that the extra cost is hardly justified. As I said in the article on multimeters, there is always room for another meter on the work bench, and the additional ranges, condenser tests, &c., which these units provide, will always be extremely valuable.

In other words I don't think such an investment will be wasted and, in fact, will be a good one if you can manage it.



The leaky AVC condenser, represented by the dotted resistor, caused positive bias to be applied to the grids through the AVC line.

And that, I think, covers most of the pros and cons of the valve tester, and I hope it will help you make a wise investment.

Getting down to the more practical side of things I have selected a rather unusual fault from this month's activities, and I think it is most interesting because it involves a relatively new type of condenser.

However, to begin at the beginning. It was a normal five valve set, only a few years old, which the owner claimed had started whistling when a station was tuned in. (Reminded me of the old gag about the railway set—whistles at every station!)

HOPELESSLY UNSTABLE

Anyway, the claim was by no means exaggerated, for it proved to be hopelessly unstable. I anticipated that it would only entail the locating and replacing of a faulty bypass condenser, most probably in the IF screen circuit.

I tried this first, connecting a new one temporarily across the existing one, but without result. After that I tried every by-pass in the set, including that from the main HT line to chassis (a most important one), the decoupler on the oscillator, plate supply, also the small RF bypass on the plate of the audio valve, and finally those around the diode load circuit, but all to no avail.

A voltage check showed normal plate and screen voltage, but the bias was higher than normal, about 5 volts across the IF self-bias resistor. I reasoned that this could only be due to one of two causes: a bias resistor which had "gone high," or an increase in cathode current. The ohmmeter established that the resistor was OK, so why the high cathode current?

Some kind of bias fault seemed the most logical suggestion, and a measurement from the grid cap to chassis, even with the standard multimeter, showed a small but definite positive voltage. It was but a step to trace this to the AVC line and finally to the diode pin of the detector valve. Leakage within the valve was a possibility, but the voltage remained when I removed the valve, leaving, as far as I could see, only one other component—the AVC coupling condenser.

This was most easily checked by removing it, which immediately restored normal bias and, when a new one was fitted, the set was also restored to normal and all suggestion of instability had vanished.

It was now becoming clear what had happened. The coupling condenser had developed a leakage of fairly high resistance and, in conjunction with the AVC load resistor, had formed a voltage divider from the HT to chassis. The leakage resistance was such as to make the AVC line a few volts positive with respect to chassis, and not much leakage was required to do this, seeing that the supply voltage was 250.

This positive voltage cancelled the normal negative bias, even though the latter was increased by the greater plate current, and the valves were running with zero bias or perhaps a trifle positive.

No wonder they whistled!

However, the really interesting part of the story concerns the reason for the leakage in the coupling condenser. A mica condenser is usually used here, but this was one of the new miniature ceramic types.

To the uninitiated these are rather amazing devices, packing a lot of capacity into a very small space, and at the same time retaining normal voltage ratings. Their small bulk makes them ideal for miniature

(Continued on page 89)

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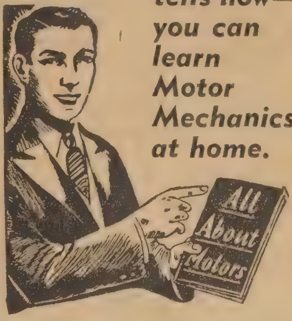

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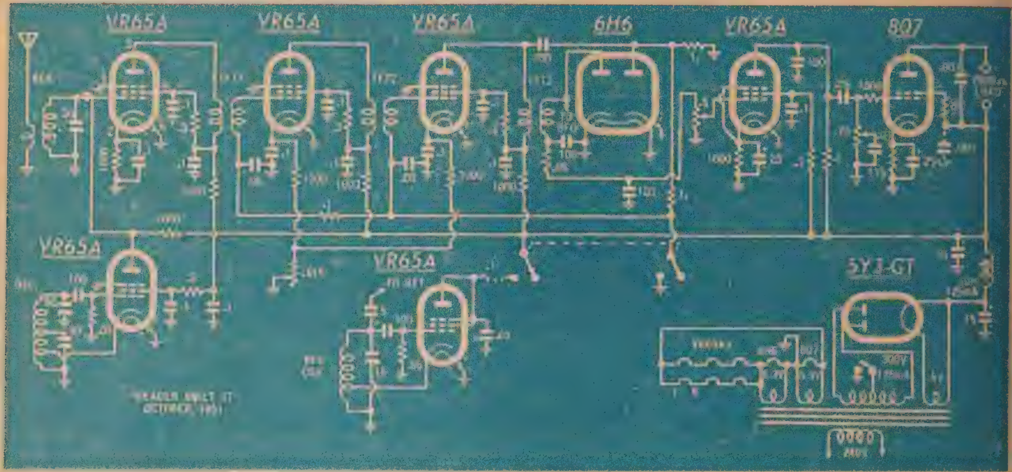
SHORT WAVE SET USES DISPOSAL TYPE VALVES



The pin connections for the VR65A are shown in the first stage. The connections for the other three types are well-known and will be found in most valve data books.

Our contributor for this month is Mr. G. J. Sharrock of Roslyn, Taggerty, Victoria, who submits the circuit diagram of a 9-valve short-wave set with all positions except that of the rectifier and possibly the audio output, filled with valves available cheaply from disposals sources.

IN all, this set employs nine valves, six of which are VR65A's, with two of the remainder also of likely disposals origin. Incidentally, the 6H6 has an electrical equivalent in the VR54.

The VR65A is the service type number for the English Mazda SP41, having a four volt .95 ampere heater. The plate and screen are rated at 250 volts, the anode current being 11.1 mA and the screen current 2.8 mA for a bias of minus 2.1 volts. Under these conditions the mutual conductance is 8400 micromhos. The VR65 is the same valve electrically but has a 6.3 volt heater.

Such high gain within one stage can be quite an embarrassment and, accordingly, the circuit from our contributor shows these valves in the RF and IF stages operating with increased bias and reduced screen volts to assist in "tying" the stages down. Even so, it will be necessary to watch the length of plate and control grid leads to these stages, preferably keeping them as short as possible and arranging the layout so that they are well separated. Furthermore, use low or medium-gain high selectivity 455Kc IF transformers instead of the higher-gain standard types for the three positions.

The main tuning is provided by the 50 pf capacitor tapped down the oscillator coil. The position of this tap will govern the degree of bandspreading of each set of coils. The 50 pf across the oscillator coil is the bandset capacitor, while the 50 pf across the aerial coil is simply peaked for maximum level.

PLUG-IN COILS

As our contributor mentions, the circuit follows very closely along the lines of the Short Wave Seven of the March, 1949, issue of Radio and Hobbies, the main exception being in the use of an 807 in lieu of the 6V6-GT and a pentode audio voltage driver instead of one-half of a 6SN7-GT. The coils are of the plug-in type and the winding data is as for the Short Wave Seven. Unfortunately there is insufficient space to reprint the data here. It is available, however, through our query service.

Note the method of providing the VR65A valves with a nominal four volts for the heaters. The six of them make up nicely into two strings of three in each across the 12.6 volts obtained by series-connecting the two 6.3 volt windings. These windings will need to be phased correctly and the easiest way to do this is temporarily to connect one end of one winding to one end of the other and brush the remaining ends together. If there is a spark, all will be well. If there is no spark you will need to reverse one winding.

It would be wise to point out that quite a few of the high Gm valves are not very satisfactory in the role of high frequency oscillator, due to the marked change in the input capacitance during the warming-up period. As this input capacitance is effective across a major portion of the oscillator, it follows that signals will drift until the valve has reached its full operating temperature. This effect is quite noticeable with the VR65A and if a more suitable type is on hand, such as a 956, 954, 6SK7-GT, &c., it would be worth making the change.

A NEW DEAL IN AMPLIFIERS

(Continued from Page 45)

tribution of distortion on a proportionate basis is very low. Much the same story is true of the second stage, although a full appreciation of its operating conditions would take rather too long to detail here.

Because of the low output plate load, a low volume control value can be used. This is very helpful in avoiding control "mid-position hum." With the usual one meg control, there is effectively a pair of .5 megs in series with the input grid, making it sensitive to induced hum. Due to Miller effect, too, there is a decided drop in high notes, even though a piece of co-axial 72 ohm cable is used to connect the control to the 6AU6 grid. Using a .25 meg pot reduces the series resistance value and even a .1 meg pot would not be too low.

The ECC33 valve is the best for the pre-amplifier, allowing useful gain. A 6SN7-GT can be used with no change in constants or wiring, but will have appreciably lower gain. It would reduce overall sensitivity to about 250 millivolts unless a larger plate resistor in the second section were used. This may call for changes in other values to preserve amplifier characteristics.

Both valve sections are de-coupled from the same circuit for stability. Their plate voltage comes from the 250 volt voltage divider in the amplifier, filtered with a 16 mfd at that point. This means that even while the valves are heating up the plate voltage is not likely to rise beyond about 300 volts. Low-voltage, small-sized condensers can therefore be used. All resistors except the decoupling resistor may be ½ watt types. Use only best quality to avoid noises.

The input voltages and output lead are connected via a plug and socket mounted on the back of the small case. A second socket is provided for tuner connection, and therefore, filament, earth and high tension leads are run across to it. The tuner will thus be earthed to the main chassis through the pre-amplifier, once again avoiding earth loops.

ASSEMBLY

The pre-amplifier can be partly assembled on the valve socket bracket using two terminal strips mounted on it. One of these supports many of the resistors, and the other the various connections to the unit. The filament, plate and output leads are wired to the amplifier socket, leaving enough slack to solder them to the terminal strips before bolting the case to the panel which supports the volume control and switch. Note that the lead to the volume control does not run near the filament leads.

Terminals may be provided for the pickup, but it is important that the lead to it is well shielded right up to the head. A braided lead of the right length was used in our case and soldered directly into the unit.

Connections to the valve socket should be made so that the low impedance pickup circuit is connected to the grid lug next to the filament. The second section grid is best kept away from possible induced hum through the socket.

In any case, a wafer socket is often better than a moulded or even ceramic socket to ensure the least possible amount of dielectric between these two often critical lugs, no matter how connected.

Connection of the compensation condensers isn't critical and they may be fitted around the switch and earthed to the most convenient points. The .04 condenser may require two .02 condensers in parallel. They can be low voltage types. The top cut condensers can be obtained in mica types from stock. Exact bridged values aren't necessary.

The final circuit as will be seen, is far from complicated, nor is the construction difficult. It is, in fact, so simple that very little of the thought and experiment which produced it is in evidence. But it fulfils all the requirements originally set out — ample reserve power (it is not intended for more than four or five watts average), extremely low distortion, complete stability, with a "flat-line" response and a microscopic hum level. It uses almost any pickup, compensates for any record, and sounds as well as any amplifier I have used to date.

Speaking of hum; care should be taken with pickup head placement to avoid inductive hum from the motor or other sources. Test for this by shorting the pickup input in the LP position.

Despite the bass boost, the hum should be virtually unchanged at any setting of the gain control. There should be no increased hum with

(Continued on page 89)

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Magnetic Recording

Magnetic heads are to tape what cutters and pickups are to the disc—their quality makes or mars the final result. The following article details some of the practical aspects of head design, for those who may have ideas of making up their own.

THE elementary concept of a magnetic head is represented in Figure 1, where a winding is placed around one leg of a stack of simple, gapped laminations.

When a signal current is passed through the winding, a corresponding magnetic field is created across and in the immediate vicinity of the gap. This field affects, in turn, the magnetic particles on the tape.

During playback the reverse process occurs, the pre-magnetised particles on the tape inducing a magnetic field across the gap. This induced field is coupled ultimately to the coil, across which appears a resulting signal voltage.

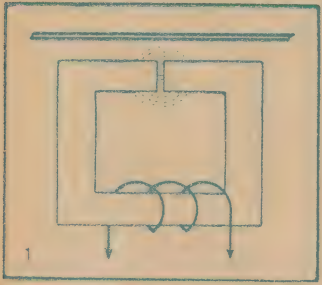


Figure 1. The elementary concept of a magnetic head, comprising a winding around one leg of a simple gapped core.

The provision of high-frequency "erase" facilities also involves the use of a magnetic head, the difference being that the winding is fed with a high-amplitude, supersonic signal. This serves to render the tape magnetically inert and free from previous recordings before the new signal is applied.

As might be imagined, there is a vast difference between a practical type of head and the elementary concept of Figure 1.

SHAPING POLES

In the first place, it is necessary to shape the pole faces so that the magnetic flux is concentrated on the outer edge of the structure so that it can couple to best advantage to the particles in the tape. To this end, the pole tips are normally undercut, so that the depth of the gap — i.e., the face width of the metal — may be as low as .04 inch.

Even then the flux does not spread far beyond the confines of the gap and the tape must maintain an intimate contact with the pole faces for the system to be effective. More shallow gaps are generally reckoned to be undesirable, since the dimension is too readily reduced and the characteristics affected by progressive surface wear as the tape passes over it.

A further important point is that a simple head, is in Figure 1, is particularly prone to pick up hum voltages from the stray fields which surround any mains transformer or drive motor located within a distance of a couple of feet.

The hum problem is particularly acute during play-back, when high amplification and bass correction is applied to the small signal voltages appearing across the head. Even with all due precautions, it remains a very serious problem in portable machines where heads, transformers and motors must be closely grouped.

PLACING THE BOBBINS

The initial precaution against hum is found in the practice of placing two bobbins on each score, one on either leg, as illustrated in Figure 2. The bobbins are usually made symmetrical and wired so that their magnetising effects on the core are additive. Hum voltages induced from remote fields tend, however, to cancel, although the effect is seldom complete.

It is generally necessary, as a further precaution, to provide shielding around the head to exclude external fields as far as possible. Shields fashioned from high-permeability alloys like mu-metal, are far and away the most effective for the purpose, although such materials are often difficult for a home constructor to procure.

The magnetic shield may also form the physical housing for the coils and laminations so that provision must be made for rigid physical mounting and for the electrical connections.

While all this does not necessarily constitute any great problem for a manufacturer, it can be a difficulty for the home constructor.

One simple approach we have seen is to use for the housing a standard cast ¾-inch waterpipe capping, which is smoothed and shaped to a suitable finish with a lathe or file. The running slot for the tape is then handcut in one face, the finished shell being plated for appearance sake.

Finally, the previously prepared laminations and coils are slipped inside the dome and carefully sealed into position with high melting point wax. The necessary leads protrude for ready connection into the circuit, while the unit as a whole attaches to the deck by two screws tapped into the body of the metal cap.

With this or any other construction, the working face of the magnet structure is open to the tape and therefore to influence from external fields. Strips of mu-metal are frequently installed beneath the head and in front of the gap to distort stray fields as far as possible and deflect them from the magnetic structure.

Although not as serious as some reports might suggest, allowance must be made for the fact that magnetic heads do wear and require eventual replacement. While "plug-in" facilities may not be considered necessary, the mechanical and electrical connections to the head assemblies should be kept uniform and simple for any given machine.

It is usual, nowadays, to provide magnetic heads with two gaps—one of the required dimension on the working face and the other on the opposite side of the structure.

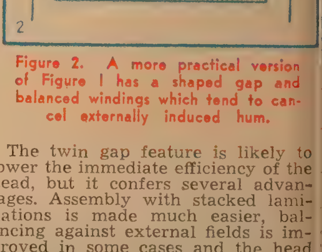
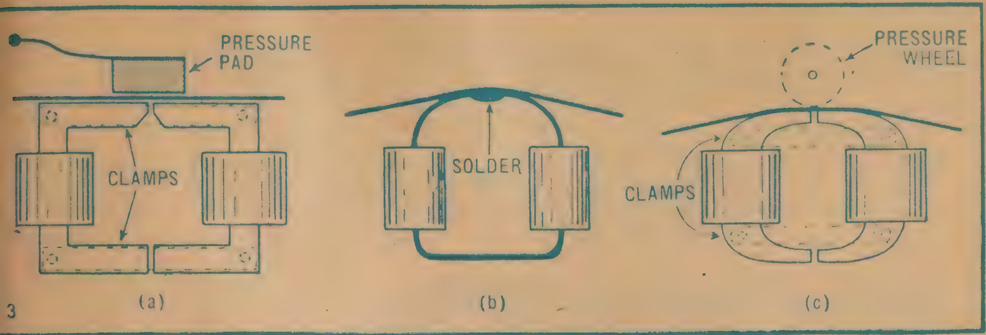


Figure 2. A more practical version of Figure 1 has a shaped gap and balanced windings which tend to cancel externally induced hum.

The twin gap feature is likely to lower the immediate efficiency of the head, but it confers several advantages. Assembly with stacked laminations is made much easier, balancing against external fields is improved in some cases and the head is generally less liable to saturation on signal peaks or to accidental "DC" polarisation.

From the home constructor's point of view, practical heads can be constructed using the materials from an old audio transformer. The laminations can be trimmed and shaped



3

igure 3. Illustrating three practical types of heads. (a) is a simple head with flat surfaces, (b) uses a single turn lamination and (c) specially shaped stampings, as used in commercial recorders.

th the aid of a vise and hand ols, while the fine wire from the ndings can often be used for the bbins. A possible short-cut is to e the bobbin from a discarded high- pedance earphone, cutting lami- tions to suit.

Simple head designs may appear in e course for home construction.

In commercial practice, the lami- tions are made almost invariably mu-metal or other suitable high- rmeability alloy, the purpose being avoid core losses and to achieve aximum inductance for a given ass of iron and number of wire rns.

Apart from being expensive, most the high-permeability alloys must carefully treated if their excel- nt magnetic properties are to be re- ined. Normal practice is to stamp e laminations and perform all itial shaping functions on the raw etal, after which it is carefully eat treated in an inert atmosphere. hereafter, the core is subjected only final polishing, ready for instal- tion in the recorder.

Home constructors, who may at- mpt to use mu-metal laminations, ust proceed with the greatest care. ammering or punching will almost rtainly ruin the magnetic proper- es of the material, but indications e that careful snipping and filing, sing vise pressure, &c., will not use undue harm.

In arriving at the shape for the minations and for the head as a hole, many factors have to be taken to consideration.

For home-constructed heads, using dinary hand tools, a popular ap- roach is to use ordinary lamina- ons cut and filed to produce squared rners and flat surfaces (Figure 3a). he initial shaping can be achieved sing as a guide the jaws of a good se, final surface finishing being a good-quality oilstone. This rocess of finishing would normally e carried out after the head was mpletely assembled.

RESSURE PAD

It is absolutely vital that the tape e pressed firmly against the actual ge of the gap and, with a flat mag- et structure, this usually involves aving a felt pressure pad bearing ainst the opposite or smooth side the tape.

Still another simple approach, hich has many variations, is shown Figure 3b. Here the bobbins are either leg of a single layer mu-metal lamination, bent in the form of a loop. The prescribed gap is provided at the top and the unit made mechanically firm by flowing solder across the inside surface. The gap is not short-circuited magnetically by the non-magnetic metal.

Where the working face of the magnetic head is curved, intimate contact can be maintained with the tape by keeping the latter under tension so that it follows the natural curvature of the working face. Naturally, the face must be free from high spots, or the tape may be lifted away from the gap.

TAPE TENSION

While both the foregoing schemes are practicable, the preferred method and the one employed universally in commercial machines is to use stacked laminations, having the general shape indicated by Figure 3c.

The laminations are stacked to a thickness of about 3-32in for a twin-track machine, or considerably wider where the full width of the tape is to be used.

Each individual "leg" is assembled with its bobbin, the surfaces are ground and the two halves fastened together, leaving the required gap between the working faces.

The surface is then ground smooth to minimise tape wear. Final polishing is often accomplished by mounting the head in a machine and running tape over the surface for a couple of hours.

As with Figure 2b, the usual procedure with this type of head is to maintain the tape under tension, so that it follows the curvature of the surface and remains in intimate contact with the gap edges. In some cases, a pressure roller is added to smooth out the effects of any possible buckle in the tape.

Still another common scheme is to run the tape around the surface of a large rubber drive-capstan, the head being spring-loaded to press against the sensitised surface.

These observations are more or less general in character and apply to all heads. In detail, however, the optimum specifications for the three types of head—erase, record and reproduce—vary considerably.

The most advanced machines normally use three separate heads, each one being designed to fulfil its own special function to the best advantage. More simply, two heads are used, one for erase and the other for record and playback. Very careful design is necessary with a composite head of this type to obtain satisfactory results with both applications.

Some simple machines have even combined all three functions in the one head—a workable scheme, but one involving a serious compromise, unless a composite twin-gap circuit is employed.

As far as mechanical construction is concerned, the erase head is probably the least critical of the three types. For the tape to be properly erased, as it passes the head, the field pattern at the gap must be so arranged that each particle is swung through several cycles at saturation level, the induction thereafter diminishing through several more cycles until the particle is left magnetically inert.

To achieve this condition, it follows that the erase frequency must be fairly high and the gap length fairly long to allow all this to happen at the chosen tape speed.

Here a compromise must be made, because too high an erase frequency makes it very difficult to saturate the gap and the tape. In any case, many times the voltage and current is required than would be the case if a DC or low frequency alternating supply were to be used for the purpose. (Actually, DC and low frequency AC erase have been used, but they have serious disadvantages in other directions.)

LIMITING FIELDS

In practice, it is usual to select an erase frequency in the 40-60 Kc. range and to provide a gap of about 3 mils in the erase head. The gap space is normally filled by a scrap of brass shim, which prevents the gap from becoming contaminated with powder from the tape.

For the erase oscillator, the most popular choice is a valve like the 6V6-GT or the 6AQ5, operating under conventional class C conditions.

Portion of the output from this same oscillator is fed to the record head to serve as the high frequency or "AC" bias.

With twin-track machines, greater care is necessary with the erase head to prevent its field straying into the adjacent track. Improper design can lead to partial erase of the second track.

For the recording head just the reverse requirement applies, in that

(Continued on Page 93)

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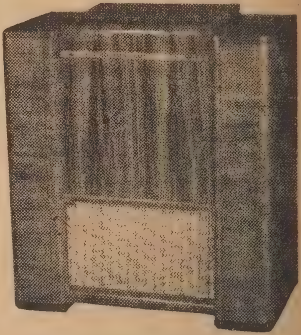

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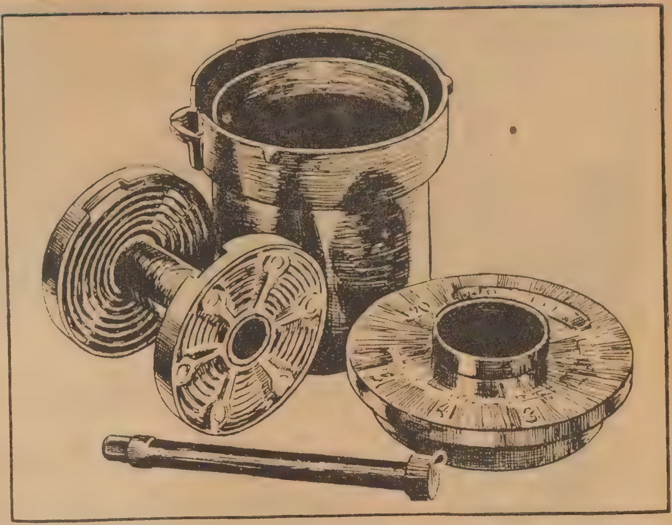
FURTHER HINTS ABOUT DEVELOPING

IOSE of you who commenced your photographic experiments und the time the first of these icles appeared should, by now, 'e mastered the few little tricks handling a film by the light of a table safelight.

3ut I know that many of you are t itching to take advantage of the ter panchromatic films if only you ld overcome this total darkness g. Before we discuss the various proaches to this problem it might interesting to consider briefly the perties of these films so that we y better appreciate why such pre- itions are necessary.

'irst point to get clearly is that a ichromatic film is not necessarily ast one, as this word simply means nstive to all colors." This is dis- ct from orthochromatic emulsions, ich are most sensitive to blue, netimes extend as far as yellow, : never to red.

Admittedly many modern pan- 'omatic emulsions are faster than ortho types; but, on the other nd, fine grain emulsion are no ter and, in some cases, slightly the wer of the two. Farther down scale we have the much slower rieties coming under the general ssification of "process," where we ll find the panchromatic emulsion th but a fraction of the sensitivity the more popular roll film types.



This picture shows the component parts of a typical non-adjustable tank which are the tank proper, the lid, the stirring rod, and the all important spiral. The construction of the adjustable type is similar, but one end of the spiral slides along the centre core and engages locating slots representing various film widths.

Are you scared of the dark? Oh, I'm not suggesting that you imagine bogy men and dragons lurking behind every dark corner, but it is more than likely that the instructions "develop in total darkness" have you worried. They have? Right—let's see what it's all about.

by Philip Watson

It is the difference in color sensi- 'ity rather than speed which ikes necessary the total darkness ndition, so that a fine grain pan- romatic emulsion will still need be handled this way, even though speed is actually less than that an ortho grade, which may be fely handled in red light.

ETHODS

Having established the reason for tal darkness and that it cannot be oided, let us now consider the rious methods of working under ese conditions. There are three proaches to the problem, as fol- ws:

(1) Dish development exactly as r ortho types, but in total dark- ss.

(2) Dish development with a suit- le safelight after desensitising.

(3) Tank development.

Let us take these in order. Al- ough you may have some misgiv- gs about the idea, it is quite prac- al to use your normal dish method ithout the benefit of a safelight. fact, the writer used this method r a number of years before finally ccumbing to the greater conveni- ice of a tank.

Main thing is to get a little prac- e under less exacting conditions an the real thing, and about the siest way to do this is to develop e or two rolls of ortho film without e safelight, but making sure it is readily available if you should get into a jam. A good scheme is to have an assistant stand by the safelight switch to turn it on if needed, but make sure he is nowhere within range of the white light switch, or the inevitable is bound to happen!

You will probably find (because you know the light is there if you want it) that you will be able to carry out the whole sequence of operations without difficulty, and with a few such rehearsals you will feel confident to tackle the real thing.

LAYOUT

However, there are a few details which are best kept in mind. Dishes, carrying their appropriate solutions, should be laid out on the bench in logical sequence, with plenty of space between the developer and fixer to avoid possible contamination. Everything you need must be laid out on the bench and the position memorised. Everything you will not need must be cleared away.

If, by chance, you have avoided the use of film clips up till now, get a pair before you start this phase of work. The preliminary water bath is more important than ever, as any tendency to curl will make the film quite unmanageable. Follow your accustomed procedure as closely as possible.

Timing is one of the biggest problems under these conditions, but there are several ways of tackling it. About the simplest is to have someone outside the darkroom with the timer who can advise you when the required time has expired. Although simple and probably satisfactory for your initial experiments, you may find that, as time goes on, there will be lack of volunteers for the job and it is as well to think in terms of something which will make you more independent.

TIMER HOOD

All sorts of schemes will suggest themselves to the ingenious, such as buzzer circuits operated by the hands of the timer, &c., and, if carefully made, can be quite satisfactory. Remember, however, that you are at the mercy of these devices once you commence operations, and they must be reliable. They also have an unpleasant psychological effect as one's sense of time seems to go completely

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ry under these conditions and ere is the perpetual fear that the vice has failed simply because it ems a long time since the opera- n was started.

A far better scheme is one where e timer can be actually seen with- t allowing any light to reach the m. This can be done by making very deep hood consisting of a tube out 12 inches long and being a at light tight fit around the frame the timer. Inside the hood near e dial is located a small panel or rch lamp covered with several icknesses of green celluloid or llophane.

This may be operated from a ansformer or dry cells and is eferably controlled with a foot itch. A small shade should pre- nt the direct rays of the lamp ining toward the operator.

The complete unit should be ounted at eye level opposite the sition you will occupy when de- loping and, in use, it should be rned on for a few seconds only at time. The strength of the light ould be no more than sufficient to ad the dial and additional layers green material may be added if o bright.

EASON FOR GREEN

The mention of green light may ggest that this color is relatively fe for panchromatic emulsions and some extent this is so. Several lm manufacturers market suitable felights, but these must usually be ed with such restrictions that they e of little real benefit.

Green is chosen not so much be- use of the insensitivity of the film this color, but rather to take ad- antage of the high sensitivity of e eye in this region. The light ed must be very carefully chosen r correct color and must be used ith the prescribed size globe usually 15 watt) at not less than specified distance which may be to 6 feet.

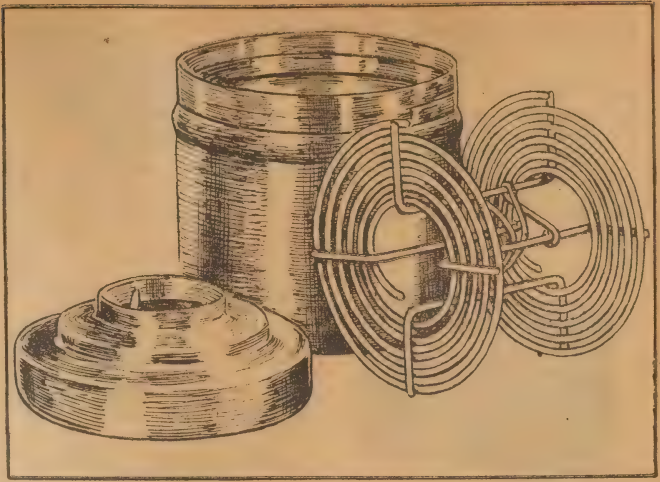
Even with all these precautions e light cannot be used until the evelopment has been in progress r some time and the sensitivity has llen as a result.

Considering all these restrictions ere seems little to be gained from ch a safelight and most makers commend total darkness in prefer- ce. In no circumstances should u attempt to use just any green ght which happens to be handy, r the result will most certainly be fogged film.

Our second method is to desensi- se the film either before or during evelopment, and then proceed by e light of a more or less normal afelight. Though probably a new ea to many, it has been a popular heme for many years, although the nk has tended to supersede it in ore recent times.

ESENSITISER

Most usual method is to desensi- se before development by passing e film through a dye bath which educes the sensitivity to a small action of the original figure with- ut in any way affecting the latent nage or the effective sensitivity at e time of exposure. A suitable afelight, according to the film and ype of desensitiser, may then be rned on and the rest of the opera- ons conducted in comparative com- rt.



The centre loading type tank has a spiral made of stainless steel wire. The clip in the centre holds the end of the film enabling it to be wound into the spiral from the centre out.

Quite naturally the actual desensitising must be done in total darkness, but this is much easier than development as the time is brief, from 30 to 60 seconds, and not particularly critical as long as the specified minimum is given. This means that the operation can be timed quite accurately enough by counting, it being not difficult to count reasonably accurate seconds with a little practice.

The two dyes most commonly used are pinacryptol green and pinacryptol yellow, and these may be obtained in a number of brands, either pure or with slight modifications by individual makers. The maker's instructions should be followed regarding the mixing, type of safelight, &c., but, as an example, pinacryptol green should be mixed in the proportion of 1 gram of dye to 500 ccs of water. This makes a stock solution, which should be kept tightly corked in a dark bottle.

For use this stock solution is diluted by 20 to 1 and two to three ounces will be sufficient for a standard 120 film, and should then be discarded. This solution has an effect on some developers, causing hydroquinine to work slightly faster and amidol very much slower. However, the latter is not used very much as a film de-

(Continued on Page 79)

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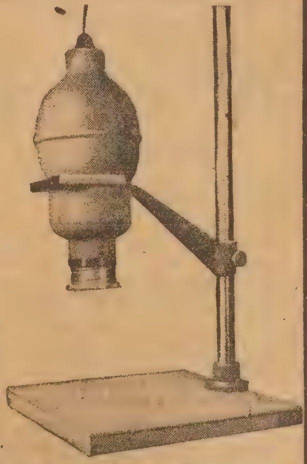

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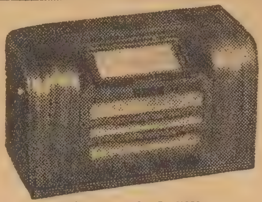

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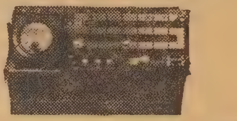

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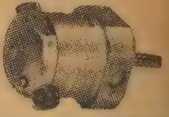

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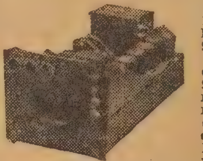

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MORE HINTS ABOUT DEVELOPING

(Continued from Page 77)

›per, due to its poor keeping lities.

lthough the maker's instructions ıld be followed, the usual safe-t is a green or yellow-green, but be much brighter than that nally specified for panchromatic erial. A red light should be ided. A typical example is the rd bright green type 909 which ıtended to be used with panchro-ic materials which have been ted with Ilford Desensitising low. It is not certain whether se are at present available on the tralian market.

E TANK

ur third suggestion is the tank, ich is what you will probably fin-up with anyway, even if you manage without it for the pre-t. This is a rather ingeniously de-ıed light tight container, of either elite or stainleses steel, fitted with spiral holder, which carries the gth of film in the form of an open , with a small space between each er.

arefully light-trapped spouts ble solution to be poured into or of the tank without recourse to darkroomfi and also enable the al holder to be rotated with a cial rod, thus providing the neces-y agitation. All this means that e the tank is loaded, which must done in the dark, all subsequent rations may be carried out under mal lighting conditions and, in t, the film need not be removed from it until it is ready to be hung up to dry.

There is no doubt that this has many advantages. There is no chance of fogging the film; it is protected from mechanical damage; there is less chance of contaminating the developer and, as important as anything else, it is far less exhausting physically.

However, it does create a few little problems of its own. One is the loading in the dark, and it must be admitted that a film which jams in the spiral with only a few inches to go, and then refuses to move either way, can give rise to some of the most colorful expressions one is likely to hear for many a day.

Just what causes these jams is sometimes difficult to say, for, although there are certain obvious causes, they will occur in spite of one's most careful precautions.

Most imortant of all is to see that the spiral is perfectly dry, for a single drop of moisture in the spiral groove will most certainly cause a jam. This is not a problem when only a single film is to be processed at a time, but where several are to be handled it can be.

The most satisfactory way of ensuring quick drying is to rinse the spiral in hot water, but this may affect the temperature of the developer in the following operation.

Some tank makers will supply additional spirals as spare parts and, if it is likely that many films are to be handled at once, an extra one or two will enable you to work without interruption. This is a point worth checking on when you are buying a tank.

Another difficulty is the natural curl of the film, which has a much smaller radius than the spiral and, if allowed to remain, particularly on the leading edge, will prevent it from sliding freely in the groove. Although all roll films will suffer from this defect, by far the worst is the 127 size, which is wound on a very small spool.

It is usually possible to straighten the leading edge by rolling it gently in the opposite direction with the fingers. However, avoid creasing it, as this can be just as bad as a curl, the idea being to make it as nearly flat as possible.

FREEING A JAM

Another possible cause of trouble is perspiration from the fingers causing the edge of the film to become slightly sticky, but there does not seem to be much which can be done to prevent this.

In any case you will find that if a jam occurs in spite of all your efforts, it can usually be freed by tapping the spiral gently on the bench, while, if the worst comes to the worst, the film can be removed for a second try. In the case of an adjustable tank this can be done by separating the two ends of the spiral, but remember that you will have to get it back to the right setting while still in the dark.

A better idea is that recommended for a fixed tank, where the film is given a slight longitudinal curve and pulled off the spiral sideways, the

(Continued on Page 81)

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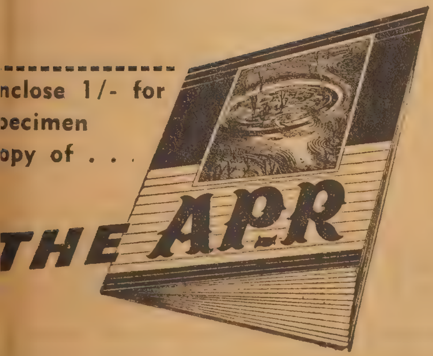

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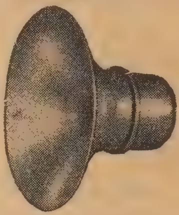

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MORE HINTS ABOUT DEVELOPING

(Continued from Page 79)

ter being allowed to revolve as film is unwound. Obviously these asures need only be adopted if jam is so bad that the film can- be moved in either direction. ien it can be moved, the jam can en be cleared by simply juggling film back and forth.

Another major objection to the k is that it requires more solution an the dish system, an objection ich is partly overcome by diluting developer and increasing the de- lopment time. However, if only same amount of chemical was ed as for dish work, the degree of ution would be so great as to ren- r the time inconveniently long. us some compromise is necessary, d even then the time can approach ree-quarters of an hour at the lower nperatures.

AVING DEVELOPER

Since more chemical must be used an the minimum required for the ea of film, it follows that the de- loper will still be active and pable of further work, although at slower rate. This is one way in ich the economics of development n be kept within reasonable unds, always providing that one ows by how much the subsequent velopment times should be in- eased.

The better quality prepared de- lopers, particularly those intended r tank use, carry this information their intsruction sheets or supple- entary data bulletins. An excel- nt example of this is the Kodak icrodol developer booklet, which ntains a most comprehensive haustion table as well as much her valuable data.

One reason why most tanks need lot of developer is because they e made to accommodate a variety film widths, and in particular the mm size. A 36 exposure roll of mm is about 5ft long, roughly vice that of a normal roll film, and e spiral must be made large enough accommodate this length even ough it is not required for any of e other sizes. Thus most tanks ill require 24oz of solution to de- elop a 120 or 620 size film.

IXED TANK

An exception to this is the J-20 pe, which only requires 10oz for 20 or 620, but unfortunately is a xed type and suitable only for these izes.

When preparing to load your tank, ake sure that you have plenty of lear space on the bench, that every- hing you require is within easy each, and that you know where each tem is to be found. If the tank is n adjustable one, make sure that t is correctly set before you turn he light out. As with your dish xperiments, it is a good idea to nake your first attempt with a roll f ortho film so that the safelight an be turned on in case of trouble.

With the tank loaded and the lid eplaced, the white light may be urned on. It is a good idea to fill he tank with clean water (at dark- oom temperature) and agitate the ilm to ensure that it is thoroughly wet and free from air-bells. The water is then poured off and the developer poured on. This should be done as quickly as possible and without any interruption, otherwise you may find a line of demarcation running the length of the film at the point where the break occurred.

AGITATION

The spiral should be rotated at regular intervals to allow fresh developer to reach the film, and in general the more frequently this is done the greater will be the rate of development. While there appears to be no objection to continuous agitation if you want a greater degree of development, it is important to guard against too much vigor in rotating the spiral, as this may cause streaks and uneven development.

With the development time complete, the developer should be poured off and, if you intend to leave the film in the tank for washing, the fixing solution should be added. However, if you prefer, the film may be removed from the tank at this stage and the fixing carried out in a dish. It is not necessary to return to the darkroom to remove the film, as it can be rendered safe by filling and emptying the tank twice with cold water. It is advisable, however, to avoid very bright artificial light or daylight.

If left in the tank, the film should be fixed for 10 to 15 minutes (progress can be checked visually), and is then ready to be washed. The tank makes this process very simple, as it is only necessary to place it under a tap and allow a moderate stream of water to flow into the centre of the spiral. Thirty minutes is usually long enough to free the film of fixer.

A type of tank which is becoming increasingly popular is the centre loading type. This has a spiral made of stainless steel and equipped with a clip in the centre to which the film end is attached. The spiral is then rotated and the film is wound into the grooves from the centre out. Not only is loading much easier by this method but it can be carried out while the spiral is wet. These tanks are invariably of the non-adjustable type.

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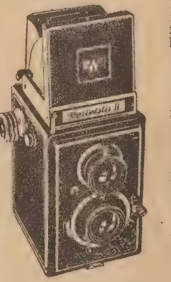

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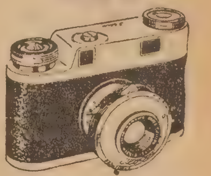

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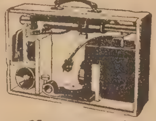

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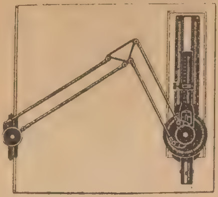

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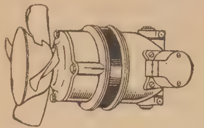

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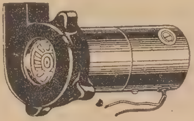

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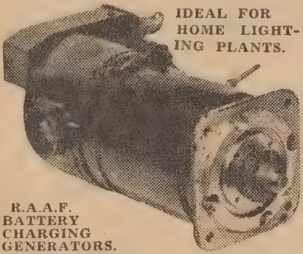

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Easily converted for use on dummy levels.

Can be used as rifle sight.
Excellent magnification .. £4/19/6

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Geniune Army Pattern.

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Extra Strong.
Cut anything .. 15/- Pair.

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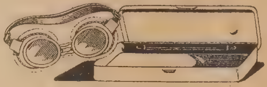

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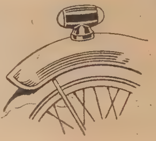

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2.2 cubic feet, will pump up to 75lb.

Never before at this price.

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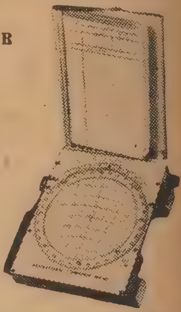
DALTON COMPUTORS IDEAL FOR AERO CLUB, A.T.C., ETC.



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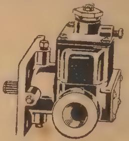
STAINLESS STEEL VANES.



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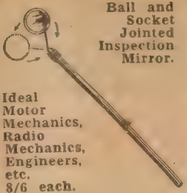

Ball and Socket Jointed Inspection Mirror.

Ideal Motor Mechanics, Radio Mechanics, Engineers, etc. 8/6 each.

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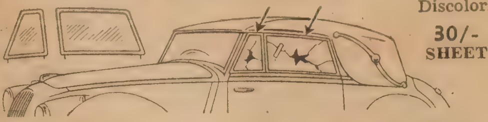

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30/- SHEET.

Non-inflammable cellulose sheets is recommended for making all types of side curtains, is 1/20th of 1in thick and sheets are 24in x 52in. Can be sewn or cemented into frames.

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2-Piece Steel Fishing Rod ..	15/6
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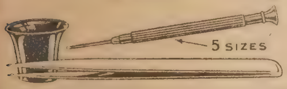

English Tweezers	5/-
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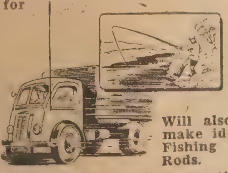
Too long for postage, advise nearest Railway Station. Base to suit Aerial



8/6

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12ft long. 3 sections. Each section 4ft. 25/-. 8ft long, 2 sections 15/-.

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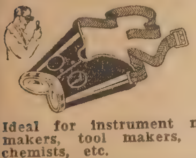

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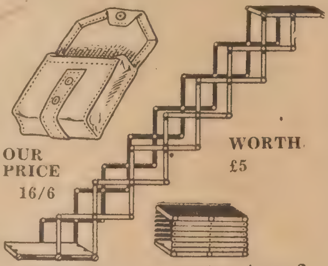
Remember there is going to be a Royal visit soon. See over any crowd. Fits in your pocket.



OUR PRICE 16/6

WORTH £5

Why stand on your toes to see?

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0-1 mil-amps. 2½" dial .. 37/6
American Weston 0.50 voltmeters, 42/-.
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BE EARLY FOR THESE WATER DRIVEN CAKE MIXERS; WORK OFF ANY WATER TAP.

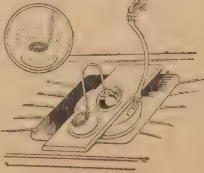
Brand New

Ideal for Country Users.

Will fit any sink.

Why pay for an expensive mixer? ?

ONLY 39/6.



LUCKY PURCHASE BRAND NEW ENGLISH ARMY SPOTLIGHTS

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6-volt 37/6. 12-volt 25/-
Fitted with Mirror Reflector.

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Genuine British 4 Draw, 22 Magnification Rifle Range Telescopes, **£6/19/6.** Commando Pocket Telescopes, **39/6.** Brand New English headphones, **17/6** pair. American Feeler Gauges, **8/6.** Dental Inspection Mirrors, **6/6.** Mudguard type rear view mirrors, **19/6** Binoculars now carry Luxury Sales Tax. We have a limited quantity 8 x 30 French, coated lens, worth nearly double our price, **£19/19/-.**

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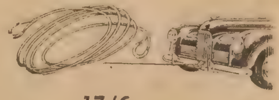
English interchangeable blade surgical scalpels handle and 3 blades, **10/6.** Ideal for hobbyist. American pyrene car type fire extinguishers worth £5/10/-, **£3/5/-.** 6ft. Steel folding tapes, **6/6.** Brand new English vernier calipers fitted with depth gauge, **25/-.** Motor-cyclists trousers waterproof, **52/6.** Large size horseshoe magnets, **7/6.** 3½" parobolic reflector mirrors, **15/-.** 10½" **39/6.** Build yourself a spotlight or useful for photographic work. Dental handpieces useful for engraving, **25/-.**

SPORTS BINOCULARS Polished Glass Lens, screw focusing, **35/-.** New English heavy duty variable Resistors, 2 ohm 12 amps. Ideal for field regulation lighting plants. **35/-.** DPDT aerial change over relays, ideal for transmitters, **22/6.** Brand new telescopic car radio aerials 8ft 6in long. Fold down to 13½", **59/6.** English spiral screwdrivers, **16/6.** English 1-pint blow lamps, **48/6.** English extra longnose pliers, **9/6.**

AT LAST! AT LAST!

ARMY STEEL TOW ROPES.

Complete with looped end.



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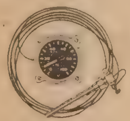
BRAND NEW REMOTE CONTROL TEMPERATURE GAUGES.



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Ideal for cars, tractors, boats, ovens, etc. Never before at this price.

Telephone FJ5904

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Lucky purchase Marine Binoculars. Precision lens. These glasses must go up in price. While they last £5/5/-.

SHORT WAVE NOTES BY RAY SIMPSON

RADIO HOLLANDIA—NEW GUINEA

Quite an amount of interest is being taken in Radio Hollandia which is now being heard very well nightly. Thanks to two of our readers, Mr. F. J. Smedley, of Landsborough, Qld., and Mr. M. Randal, of Crows Nest, NSW, we are able to give some interesting information which they have received direct from the station.

THE letter of verification was received from the director of the station, Mr. G. F. van Velzen, who wrote as follows: "We may inform you that this is the official Government broadcasting station for Netherlands New Guinea, operating with 500 watts, and located on Gentani aerodrome, near Hollandia, well known to Australian airmen. Our transmissions take place daily from 0915 until 1130 GMT.

New installations are still under construction and in the near future an increase in power and broadcasting hours is to be expected. For your guidance we are including a general program schedule in English. As regards our frequency, this was indeed announced originally as being 7160 Kc., but due to some trouble with transmitter crystals we had to switch over to 7216.6 Kc.

"This new frequency seems to be more suitable as it is reasonably free from interference from other stations. Of course, there will be a certain amount of 'ham' interference on this frequency band."

The station comes on the air with the Washington Post March, followed by a program review. Among the many items broadcast are 8.15 pm Sydney time on Monday Andre Kostelanetz and his orchestra; 7.40 pm, Tuesday, Catholic session; 7.45 pm, Wednesday, Quiz Program for the Forces; 7.40 pm, Thursday, Opera Music or Musical Comedy; 7.40 pm, Saturday, Ivory Keys.

While speaking of this part of the world, we note that a new 50 Kw. transmitter has arrived in Djakarta in Java and is expected to be in operation early in 1952 Radio Australia tells us it will operate in the 19, 25, and 31 metre bands. A 7½ Kw. transmitter is en route to Indonesia and will be installed at Jogjakarta upon arrival. It will replace YDJ 5.06 Mc. and YDJ2 7.1 Mc. will then change frequency.

NEW ZEALAND.—A seasonal change has again taken place in connection with the transmissions from Radio New Zealand and thanks to the DX session from Radio Australia we are able to give their new schedule which came into operation as from September 4, 1951.

4.00 am to 6.45 am:
ZL2, 9.54 Mc., to Australia.
ZL3, 11.78 Mc., to Pacific Islands.
7.00 am to 4.45 pm:
ZL10, 15.22 Mc., to Australia.
ZL4, 15.28 Mc., to Pacific Islands.
5.00 pm to close:
ZL2, 9.54 Mc., to Australia.
ZL3, 11.78 Mc., to Pacific Islands.

Station closes week days at 8.45 pm: Saturdays, 9.20 pm: Sundays, 8.00 pm.

DANISH STATE RADIO

We have received some interesting information direct from Radio Denmark and as it concerns reception in Australia we reproduce it in full. "In February, 1949, the Danish Short wave opened a Far Eastern Service beamed to reach the entire huge area stretching from India to New Zealand. During the past 30 months we have had some difficulties in penetrating the ether and our broadcasts have never really got beyond the experimental stage.

"At present we present three-hourly programs from Denmark on Tuesdays, Thursdays, and Saturdays, from 9.30 am to 10.30 am GMT on 15.18 Mc., followed on Tuesdays and Saturdays by a 15-minute program intended for Danish ships in Far Eastern waters. However, we are still experimenting, and we have decided to split up our service into two, one beamed toward Australia and New Zealand and one toward India and Malaya. These broadcasts can, on and from September 4, be heard according to the following schedule.

SHORT-WAVE NOTES for the November issue are due on October 6. For the December issue they are due on November 10. Please send them direct to Mr. Ray Simpson, 80 Wilga St., Concord West, NSW.

1. **Australia and New Zealand.** Tuesdays and Saturdays, 9.00 am to 10.00 am GMT, 15.18Mc., followed by a 20-minute program to Danish ships in Far Eastern waters.

2. **India and Malaya.** Tuesdays and Saturdays, 1.00 am to 2.00 am GMT, 15.18 Mc., followed by a 20-minute program to Danish ships in Indian waters.

We hope that this new schedule will improve reception of the Danish Shortwave Radio Station and that you will be a regular listener to our programs. Please address all mail to Danish Short-wave, Radio House, Copenhagen, Denmark. All letters, of course, are acknowledged."

Alterations have also been made in the broadcasts beamed to North America and as from September 2 the schedule will be as follows:—

Transmission 1: 11.30 am to 12.30 pm on 9.52 Mc.

Transmission 2: 1.00 pm to 2.00 pm on 9.52 Mc.

Of the one-hour program, 40 minutes will be in Danish and 20 minutes in English. It is hoped these new times will give improved reception throughout North America.

NEW STATION LOGGINGS

Call	Kc	Metres	Location	Time Heard.
RIAS	6000	50.00	Berlin, Germany.	3.00 pm
CR6RG	7070	42.46	Dondo, Angola.	5.15 am
PRB22	9505	31.56	Sao Paulo, Brazil.	10.00 am
ATHENS	11717	25.60	Athens, Greece.	11.00 am
VLW11	11840	25.34	Perth, WA	7.00 pm
OZH	15180	19.76	Kobenhavn, Denmark.	7.30 pm

FLASHES FROM EVERYWHERE

KOREA.—From various sources glean information regarding the sho wave stations now operating in t troubled country. The Seoul stati HLKA appears to be curently operati on 4.785 Mc. and 7.933 Mc. from arou 9.30 pm to 11.30 pm. On certain da this station relays the Voice of Ameri Korean programs. At the writer's loc tion neither of these frequencies can heard.

Another Korean station is Pyongya which is using 4.285 Mc. from arou 10.30 pm to 11.30 pm. According to Pa Dilg, of California, this station broa casts Prisoner of War messages at 11. pm. This station is also inaudible our location.

MALTA.—From the Universalite learn that the Forces Broadcasting Se vice has advised an American listen than their transmission from Malta cease as from March 7 last. Their service r verts to a low-powered medium-wa transmission to cover servicemen in t Middle East. They do advise, howeve that the station at Mackinnon Rd. wi continue to broadcast on both mediu and short waves with a power of 1 watts.

This latter transmitter operates on 14 Kc. and 6.155 Mc. Week days, 1.0 pm 3.0 pm; 7.30 pm to 9.0 pm; 12.0 pm 5.0 am. Saturdays, 1.0 pm to 3.0 pm 7.30 pm to 9.0 pm; 12.0 am to 5.0 am Sundays, 12.0 am to 6.0 am; 3.0 pm to 9 pm. Their other stations are located Tripoli, Fayid and Cyprus. The Mackinnon Rd. station on 6.115 Mc. would very difficult to receive out here ju now.

JAMAICA.—Those listeners who hav not yet managed to log stations in Jamaic or, for that matter, any of the othe West Indian colonies, are advised listen during the month of Novembe when these stations sometimes give broadcasts of race meetings and cricke matches. The best stations to monit are VRR4 on 11.595 Mc. and VRR5 o 12.05 Mc.

Other stations from which this typ of broadcast can be heard are VPO3 o 10.605 Mc. and ZNX32 on 7.547 Mc., bot these latter two stations being locate in Bridgetown, Barbados. Still anothe colony with similar broadcasts ar Georgetown, British Guiana, over ZFY o 5.98 Mc. and ZFY on 15.08 Mc. All the above stations have been heard Sydney at various times so other listeners should be equally successful.

USA.—Those of our short-wave listeners who are interested in amateu transmissions will no doubt like to kno the times of the special Radio Amateur Program broadcast from the USA. Th session is very interesting and informative and can be heard as follows: Lati America Service, 12.30 pm, Sunday, o 9.65, 11.83, 11.89, 15.21, 15.35, and 17.83 M Far East and Pacific Service, 10.30 pm Sunday, and 12.45 am, Monday, on 6.0 6.075, 6.12, 6.185, 9.515, 9.57, 9.6, 11.7 11.89, 15.105, and 15.33 Mc. Europea and Middle East Service, 5.15 am, Monday, on 7.2, 9.7, 11.87, 12.095, 15.27, 17.7 and 21.5 Mc. 7.0 am, Monday, on 6.0 6.14, 6.17, 9.54, 11.83, 11.87, 15.21, 15.2 15.35, 17.78, 21.5, and 21.65 Mc.

UNITED NATIONS.—From the Radi Division of United Nations Radio we not that English programs are now broadcast as follows: 10.06 am to 10.15 a on 9.67 Mc. and 15.21 Mc. through WRCA 2.10 pm to 2.15 pm through CKLO on 9.6 Mc. and CHOL 11.72 Mc.; 3.15 am to 3.2 am over WABC 15.13 Mc. and WRC 21.61 Mc. They also broadcst direct fro Geneva on 6.67 Mc at 4.30 am to 4.45 am

They state that "The Radio Divisio is anxious to establish contact with a many listeners as possible and will gladl acknowledge all communications." If yo request it, they will also send you verification card and a copy of the Unite Nations Charter. Address is United Nation Radio, Lake Success, New York, NY USA.

THE HAM BANDS WITH BILL MOORE

The Commonwealth Jubilee VK-ZL DX contest has been extremely well publicised overseas, and it should provide Australian and New Zealand radio amateurs with an entertaining way of participating in the Jubilee celebrations.

MATEURS here in Australia and in New Zealand have all received copies he rules by courtesy of the WIA and RT respectively, and there is every on to believe that a record entry be received.

nditions on the DX bands fortunately n to be improving and it is hoped it will hold for the duration of contest. It would appear that, as al, 14 Mcs. will be the most popular d, but, due to the scoring arrangeits which encourage multi-band operg, other bands should be well popud.

cup will be presented to the highesting station in both Australia and New land, while a plaque or medallion go to the highest-scoring stations each State of Australia and district New Zealand.

ertificates will be given to other placeers. This procedure will be adopted all countries outside Australia. Each district and British Isles prefix will regarded as separate countries. The test committee reserve the right to ide the type and number of prizes certificates to be allocated. This will end entirely on how many logs from ious countries are received.

HREE SECTIONS

he contest is divided into three secns—CW, Telephony, and Receiving e CW section, commencing at 0001 rs GMT, Saturday, October 13, and cludes at 1200 hours GMT, on Sun-, October 14. The Telephony section, nning from 0001 hours GMT, Saturday, ober 20, to 1200 hours GMT, Sunday, ober 21.

K and ZL stations for contest pures will limit their period of operan to any consecutive 24-hour period each weekend within the times given ove. Once an operator commences eration the operator will not exceed hours of operation reckoned from such nmencing time.

lost amateurs will be fully conversant h the rules; the following, however, the rules of the Receiving section listeners throughout Australia and w Zealand are invited to participate:—

The rules for the Receiving section the same as for the Transmitting tion but it is open to all members any short-wave listener's society in world. No transmitting station is mitted to enter for the Receiving tion.

The contest times and the logging stations once on each band per week are as for the Transmitting section gs will be in the same form as for Transmitting section. (A station can logged once in the CW or Telephony tion on each band, i.e., 3.5, 7, 14, 28 s. Logs should show in the following der: Date, Time GMT, Band, CW or lephony, Callsign of Station Heard, rial Number sent by the station, Calln of Station being contacted.)

3. To count for points, the callsign of e station being called, strength and ne (if on CW) of the calling station d serial number sent by the calling ation must be entered in the log. One int may be claimed for each entry mplying with the above details.

4. It is not sufficient to log a station lling CQ contest.

5. VK receiving stations may log overas and ZL stations. ZL receiving stans may log overseas stations and VK ations.

6. Awards will be determined by the ntest committee. Logs from Australia d New Zealand should be posted to ach the Chairman, Contest Committee, ox 1734, GPO, Sydney, not later than ovember 30, 1951.

You may enter the open section (CW nd Telephony), CW or Telephony secons of the contest.

All logs should be forwarded irrespective of the number of contacts.

Make it our best supported contest—you are certain to enjoy it.

One of the secondary trophies was on display at the August meeting of the NSW Division. It was a magnificent prize and anyone would be pleased to display it in the shack.

Letters from many rare DX stations, saying they will be active, have been received by the contest committee. An EA9 from Spanish Morocco says he will have the beam pointed on VK and active on CW and Telephony—choice enough DX even for some of the 200 country men.

All Australian stations, including the VK9's, received copies of the rules—membership application forms were included with the rules sent to non-WIA members and the return has been gratifying.

THE RD CONTEST

The Remembrance Day contest run in August was possibly better supported than on any previous occasion. It will be interesting to see which State runs out the ultimate winner, but again under current rules the winner should either be Western Australia or Tasmania. The VK5's were very active and should also be well up in the scoring.

Some very fine individual scores were recorded, a reflection of efficient operating. VK6RU should be among the individual leaders with VK2ZC and VK2DO well up in the picture from NSW.

Considerable interest in the contest was created in NSW by the running of an unofficial inter-zone competition The average of the six leading stations was taken and the winning zone average was in the 500-point region—some of the States would be quite proud of the score.

The bands were certainly bedlam, one old-timer, not so keen on contests, remarked on the air that if that was the way amateurs commemorate their fallen he was glad to be alive. It is not the contest but the name "Remembrance" that brings back thoughts of the 29 amateurs whose calls and names are engraved on the perpetual trophy. Perhaps we knew them in the Services, or on the air. At some period our thoughts were with them and each year at least we will remember the fallen during the Remembrance Day weekend.

Results of the contest should appear in this month's issue of Amateur Radio.

Recent checks on the operation and euqipment of amateur stations by officers of the PMG's Department have produced varied reactions. It is the first time that a really systematic check has been carried out and a number of amateurs found themselves carrying out extensive alterations before they were allowed on the air again.

Those amateurs whose final tube and power supply were not too large were not unduly worried but others who had large final tubes, big power supplies, or both, were not so happy. The main objection raised by the authorities was to transmitters that were capable of inputs in excess of the regulation 100 watts.

813's were a source of annoyance. It is a pity that there is not a Tetrode readily available, with power capabilities between an 807 and the 813. The 807 is too small for 100-watt input, the 813 definitely too large!

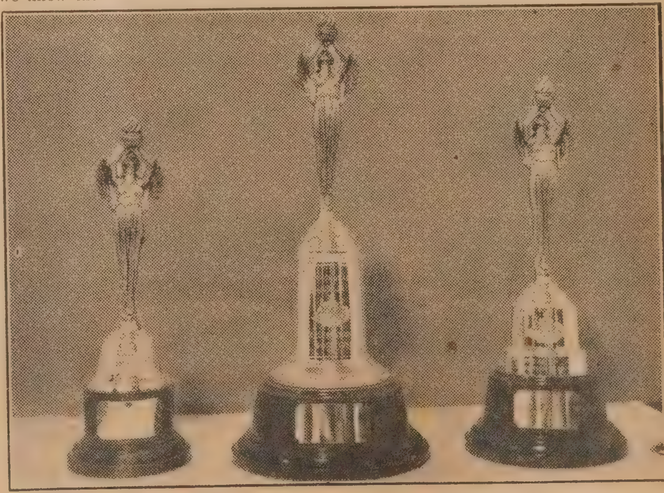
One point that cropped up during these inspections concerned the degree of coupling of the final stage to the antenna. Any transmitter running efficiently at 100-watt input can be over-coupled to produce higher inputs. Providing the power supply is of reasonable size, it would appear that the degree of coupling of the link to the final stage should be the decision of the operator, who will know the limitations of the transmitter and the impact of over-coupling on the receiver of the other amateur a few streets away.

AMATEUR CONTEST

Amateurs here in Australia do not enjoy the power privileges of other countries. In England maximum input is 150 watts, New Zealand 250 watts, and, of course, 1 Kw. in the US.

It is many years since amateurs here have requested any power increase through normal Federal WIA channels.

General opinion seemed in favor of the



Cups similar to those shown above will be awarded to major prizewinners in the Jubilee VK-ZL DX contest.

FOR PERSONAL SHOPPING

We have branches at
319-321 Swanston St.,
and 393 Flinders St.,
Melbourne, C.I.

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AUSTRALIA'S LEADING DISPOSAL STORES

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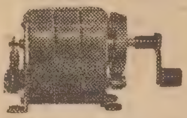
BELL RINGING GENERATORS



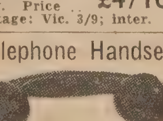
A small neat A.C. Generator complete with handle and 3 screw fixing base. Change over shaft actuated contacts for telephone ringing, shocking etc., suitable for converting Don. V. phones to bell call 37/6
Post. Vic. 3/-; Interstate 4/9.

Marching Compass

PRICE 39/6

Fitted with reflector attachment for taking bearings. Postage 2/- all States.

COMPASS TYPE P4



7in. diam. x 3½in. deep, liquid filled, spring mounted Navigational Compass. Reconditioned as new. Price . . £4/10/-
Postage: Vic. 3/9; inter. 7/6.

Telephone Handsets

Made by Western Electrics, complete with cord. Price 39/6
Postage Vic. 2/-, Interstate 3/6.

8-DAY CLOCKS

IDEAL FOR CARS AND TRUCKS

Precision built in America by the famous Waltham Clock Co. for the U.S. Navy and containing the highest quality movements. Special features include: 24-hour dial, sweep secondhand, tells civil date, handy size (3¼in. dial), and chronometer-like accuracy.
Price £9/10/-
Postage: Vic. 2/-; Interstate 3/9.

BONDING TESTERS

Low Resistance Measuring Sets, calibrated scale 0-0.1 ohm. Made by Evershed Brand New. Price 35/-
Postage: Vic. 3/-; Interstate 5/-.

HOME LIGHTING SPECIAL

BATTERY CHARGING GENERATORS

24 volt 1500 watt,
Price £17/10/-

24 volt, 1000 watt.
Price . . . . £15/-/-.

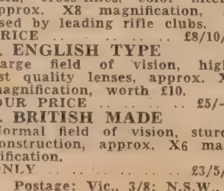
A 3½ inch V-pulley especially made to fit the splined shaft of both Generators 35/-

Also 50-0-50 Ferranti Ampmeters 50/-

Both generators can be used on 32 volt systems without alteration. Freight fwd. Rail.

PRISMATIC ELBOW TELESCOPE

★ 3 TYPES



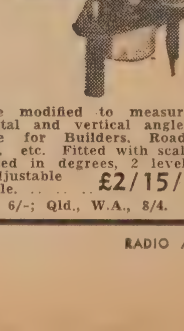
1. AMERICAN TYPE (as illustrated). Extra wide field, cross-lines, color filters, approx. X8 magnification, as used by leading rifle clubs.
PRICE . . . . £8/10/-.

2. ENGLISH TYPE Large field of vision, highest quality lenses, approx. X6 magnification, worth £10.
OUR PRICE £5/-/-

3. BRITISH MADE Normal field of vision, sturdy construction, approx. X6 magnification.
ONLY . . . . £3/5/-.

ASTRO COMPASS

BUILD YOUR OWN DUMPY LEVEL



Can be modified to measure horizontal and vertical angles. Suitable for Builders, Road-making, etc. Fitted with scale calibrated in degrees, 2 levels and adjustable turntable. £2/15/-

Postage: Vic., 3/8; N.S.W., S.A., Tas., 6/-; Qld., W.A., 8/4.

SPOTLIGHTS

Signalling Lamps

6in. reflector, 2 handles an trigger switch. Complet with 12 volt 30 watt glob All brand new. Price £1/19/6
Postage: Vic. 3/9; Interstat 7/6.

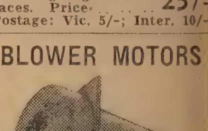
HYGROMETER

WITH CHART
For Temperatur and Humidit Reading.

Suitable for
- FACTORY
- HOME
- FARM
- DAIRY

An Accurat and high class instrumen having two thermometer with calibrated Fahrenhei reading scales.
PRICE 19/6
Postage: Vic. 2/-; Inter. 3/6

ELECTRIC MOTOR



A very useful 50 volt 50 cycle motor, which can be rewound to approx. 1/10 H.P 230 volt A.C. 3/8 in shaft self aligning ball races. Price 25/-
Postage: Vic. 5/-; Inter. 10/-

BLOWER MOTORS

24 volt A.C., D.C. Ideal for small ventilating jobs. Price 39/6
Postage: Vic. 2/3; Inter. 4/6.

tation to 100-watt input and that ver was sufficient for general purpes. Higher power is, of course, of efit during contests and we cannot npete with higher-powered stations er contest conditions.

nce the war amateurs have accumud equipment from Disposals higher gear that would not be normally ilable, or within the financial reach the average amateur. Prewar a num- of amateurs obtained high-power pers and transmitters were constructed operate above the normal licence ver of 100 watts. Under the present ulations these transmitters would no ger conform to the requirements. In w of the equipment available, the rcity of high-power permits, and the ct supervision of the department on ver levels, perhaps the time is oppore for a request for the redrafting the regulations concerning power ins. The decision for such a request uld, however, have to be one made the majority of amateurs through A channels.

o those who haven't the necessary ipment for higher power the acquir- of suitable power supplies would an extremely expensive business at moment.

ll aspects of power limitations should considered before any move is made any change of regulations. Half a Kw ist sound very loud a hundred yards ay.

VERSEAS COMMENT

Meetings of the committee of the International Amateur Radio Union, Region 1, ropean Bureau, have been taking place some time now. The meetings are der the chairmanship of S. K. Lewer, LJ, a past president of the RSGB and 1ARU delegate to the Atlantic City lecommunications Conference.

The vital task of the 1ARU is to main in the existence of our hobby in view the continual clamor for additional equencies for the various other services. is tremendously important that the nateur service be fully represented, pecially as any ground lost is gone r ever.

Many European countries do not at e moment fully support amateur radio, d it is hoped by means of the bureau assist the national societies of the untries concerned to obtain closer aison with their authorities.

Member societies will be furnished with bulletin twice yearly, covering bureau tivities and proposals to be debated on. Contests will be co-ordinated and e bureau will run the annual European X contest and originate a European HF event on 144 Mcs.

VIA NEWS

The arrangements for the NSW Division's Woy Woy Field Day are well in and. Maurice Butler, VK2AAN, Dave vans, VK2AYE, and Bill Moore, VK2HZ, re looking after arrangements at the ydney end, while Ces Hardman, VK2KR, nd John Walker, VK2GA, will be oranising at Woy Woy.

The date is November 18 and it opens t 11 am at the Woy Woy Masonic Hall. ome and meet all the Newcastle and akes gang.

The pre-lunch period will be taken up registration, raffles, competitions and e like. Lunch 12.30 to 1.30 pm and ght refreshments will be available at he hall with the usual run of free soft rinks, milk, tea, &c.

Two transmitter searches will be conucted during the period—2.0 to 3.30 pm n 144 and 3.5 Mcs.—while special events vill be run for the kiddies and XYL's.

From 4.0 to 5.0 pm will be occupied n the prize presentation, bran dip, &c.

A special swop section will be conducted o allow amateurs to exchange their urplus equipment.

Dave Duff, VK2EO, State secretary, vill be running special movie shows for iddies—big and small—with plenty of razy comedies.

YOUR OPPORTUNITY

o join the world-wide ranks of amateur ransmitters! The Wireless Institute of Australia holds regular classes in Sydney o assist Sydney and suburban enthusiasts o obtain their Amateur Operators Certiicates of Proficiency.

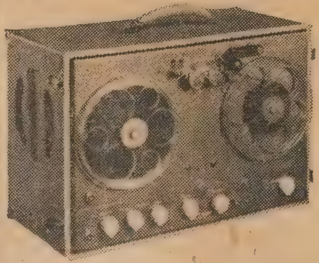
Write for particulars to the Class Manager, W.I.A., Box 1734, G.P.O., Sydney.

NOVA

TAPE RECORDERS AND ACCESSORIES

Just Released!

Type O Deck and Type XS and XPP Recorder



The extensive range of "NOVA" Tape recorders and accessories has been extended by a streamlined high fidelity deck incorporating the latest improvements in tape recorder design. With a plastic front, a straight tape feed and many other features, the Type O Deck and Type X Recorders will prove the most popular on the market.

Note these features

TWIN TRACK RECORDING, ABSOLUTELY NO WOW OR FLUTTER, owing to oversized capstan-flywheel, straight tape feed, two motors, vertical or horizontal operation, adjustable bass and treble compensation to suit various types of recording and room condition. High and Low input to match various needs, plug for external speaker, can be used as a Public Address amplifier, Pilot lamp indicators. Low price.

Type O Deck, complete, including twin track heads for one hour's play on 7-inch reel £69/12/6

Type XS Recorder (single-ended 4-Watt Amplifier) £139/17/6

Type XPP Recorder (Push-Pull 9-Watt Amplifier) £146

For other type of recorders ranging in price from £117 to £129/10/- decks and amplifiers, please see our previous advertisements or contact your dealer or us. We will gladly send you further information.

FIRST IN AUSTRALIA—THE "NOVA" "RADIOTAPE"

Portable Tape Recorder with built-in superhet radiotuner. The High Fidelity (Type H) amplifier with its extensive tone compensation will give you true-to-life reproduction never achieved yet in a portable wireless set. The powerful output stage will permit the combination with a large external speaker and the use as a P.A. System Price £153/17/6

THE "NOVA" "RADIOTAPEGRAM"

Portable Tape Recorder with built-in radio tuner and two-speed gramophone pick-up combination. Price £169/-/-

Why not build your own Tape Recorder

"NOVA" have set up a complete tape recorder service for those who wish to participate in this most fascinating branch of electronic engineering.

A complete "NOVA" kit of parts

including circuit for amplifier, oscillator coil and layout diagram, will cost you .... £40/17/6 plus postage.

These parts are the same parts as we use in our high fidelity tape decks.

CONTENTS OF KIT SET:

High Impedance Record/Playback Head, twin track (£5/7/6). Erase Head (ditto) (£5/7/6). Precision ground and balanced capstan for 7½ inch/sec. (£4/6/-). Capstan Motor with shield, fan and pulley (£7/10/6). Rewind Motor for 50 sec. rewind (£5/18/6). Take-up Clutch (£1/4/-). Brake/Freewheel Assembly for supply reel (£1/4/-). Oscillator coil (19/9). Circuit diagram with Layout (9/6). Mechanical Layout diagram (9/6). Front panel (£1/4/-), and all intermediate pulleys, spindles, reel fittings, etc.

Also available: Leatherette cabinet to take front panel 18 inches by 12 inches deck and compartment for reels, microphone, footswitch, etc., £5/19/-.

TAPE AND REELS: (Prices for 1200 feet reels).

EMI (plastic, English) £1/17/6
PYRAL (paper, French) £2/-/-
PYRAL (plastic, French) £3/3/4
MAGNETOPHONE (plastic, German), £2/19/3 on metal reels.
£3/5/9 on plastic reels.

Reels: 7" Metal, 7/9 each.

SCOOP ! SCOOP ! SCOOP !

Small Variable Transformers, 9 Volt to 16 Volt, 1.5 Amp., suitable for toy motors, model trains, festive lights, small battery chargers. 1001 uses. Do not miss this opportunity and buy while they last. Brand New. TO CLEAR (4/6 Postage) 20/-

For further particulars see our previous advertisements, contact your dealer or

"NOVA" ELECTRICAL & ENGINEERING CO.
311 SUSSEX STREET, SYDNEY.
NOTE NEW TELEPHONE NUMBERS — M 2159, M 2350.
OPEN SATURDAY MORNINGS AND WEEK-DAY NIGHTS.

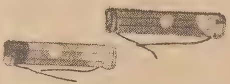
COLLARO MAGNETIC PICK-UP

Genuine English Collaro pick-ups with rest in brown bakelite. Gives good tone and output and is very reliable. Usual price £3/10/- each. Our price only .. .. 27/6 each.

CONDENSER

We have limited stocks of the following Paper Tubular Metal-cased Chanex Condensers, available as follows.

Cap.		Wkg. Volts	Price
.5	mfd	200 v	1/3 each.
.5	"	400 v	1/6 "
.1	"	400 v	1/- "
.35	"	400 v	1/- "
.25	"	400 v	1/- "
.02	"	600 v	/9 "
.01	"	600 v	/7 "
.006	"	600 v	/7 "
.0025	"	2000 v	1/3 "
.001	"	600 v	/7 "

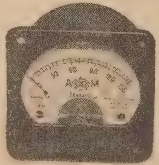


CARBON RESISTORS

Available in assorted packets as follows:—

Mixed ½ watt, 1 watt, 2 watt, 5 watt from 10 ohms to 1 meg.

Pkt. of 50 asstd. .. .. 12/6 pkt.
Pkt. of 100 asstd. .. .. 22/6 pkt.
Pkt. of 500 asstd. .. .. £5 pkt.



METERS

We have the following meters in stock. They are mostly brand new, if not, they are in excellent condition.

TYPE OF METER	
0-1 M.A. D.C. 2in scale square	32/6
0-20 0-200 D.C. volts 2in scale round	17/6
0-5 Amps. R.F. 2in scale, round	22/6
0-40 Volts D.C. 2in scale square	19/6
0-3 Amps R.F. 2in scale round	22/6
0-2.5 Amps R.F. 2in scale square	22/6
0-50 M.A. D.C. 2in scale square	22/6
0-100 Volts A.C. 2in scale square	39/6
0-20 volts D.C. 2in scale square	19/6

Please note the 0-100 volt A.C. meter is an excellent buy, as it has a 1 M.A. dry metal rectifier built into each meter.

BRITISH NAVY RESISTORS WIRE

Available in the following sizes:—

Resistance	Wattage	Price
50	10	2/-
50	85	4/-
100	40	3/-
250	20	2/-
300	85	4/-
350	25	2/-
400	20	2/-
500	27	2/-
600	40	3/-
700	25	2/-
850	20	2/-
1000	85	4/-
1000	120	5/-
1500	10	2/-
2000	25	2/-
2500	10	2/-
2500	85	4/-
3000	25	2/-
3500	10	2/-
3500	25	2/-
3700	30	3/-
5000	20	2/-
5000	55	4/-
5500	12	2/-
10000	55	4/-
15000	25	2/-

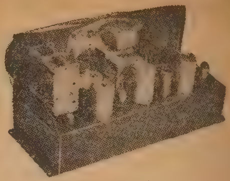
WIRE WOUND RESISTORS

20 WATT

50, 75, 100, 125, 150, 175, 200, 250, 300, 400, 500, 750, 1250, 1750, 4000, 7500, 12500, 15000, 17500.
Price .. .. 2/- each.

25 WATT

50, 75, 100, 125, 175, 200, 250, 300, 400, 500, 740, 1500, 1750, 2000, 2500, 3000, 4000, 7500, 12500.
Price .. .. 2/6 each.



RADIO CHASSIS FOR THE COUNTRY MAN

Extra Special 5-valve Broadcast, all dry Battery Mantel Radio Chassis with R.F. Stage — gives extra long range and is economical to run. Has straight line dial and built-in 7" speaker. All sets in working order.

Price (equipped with valves, but less batteries) £16/10/-

Price (complete in cabinet, but less batteries) £21/-/-

Set of Heavy Duty Batteries for same. Price .. .. £4/4/8.

RECORD PLAYERS

This Record Player uses a well-known brand of English Electric Motor, and a good English Magnetic Pick-up.

The unit has a 2-pin socket for A.C. Connection and shielded lead for pick-up. It is extremely light in weight and is beautifully finished in Brown or Black Leather Cloth.

Price .. .. £9/10/-.

NOTICE

All parcels will be sent registered post unless otherwise stated. Postage or freight must be included with all orders.

M/S MOTOR SPARES LTD.

547 ELIZABETH ST., MELBOURNE

IGHT—SEEN AND INVISIBLE

(Continued from Page 13).

e above may be explicable to a ist and it is quoted to show to lengths speculation has run be- of infra-red photography.

e invisible light of ultra violet although of not much use to the nomer, has been of very great tance to the workers in the ical field.

stated previously the farther goes below the violet end of the le spectrum the shorter become wave-lengths of the radiations d there.

the measurement of wave- ths it is too cumbersome to refer e various wave-lengths in frac- of an inch. To overcome this culty the term "Angstrom" is used.

is term was so named in honor e Swedish scientist A. J. Ang- n whose special field lay with spectroscope.

angstrom is one hundred mil- h of a centimetre. A very ll measure indeed. The shortest le light has a wave-length of angstroms at the violet end of spectrum and the longest wave- th of visible light lies at the end with a length of 7000 ang- ms.

eyond the violet we proceed to shorter and shorter wave-lengths through the ultra violet until a wave-length of 100 angstroms is reached. From there to a wave-length of one hundredth of an angstrom lie the x-rays and from there we proceed down to the gamma rays.

It is difficult to imagine anything as short as one hundredth of a hundred millionth of a centimetre and more difficult to imagine anything smaller. Yet such rays exist.

When an atom is excited to a certain state of energy it gives off visible light. It gives off ultra violet at a higher energy state and x-rays at a still higher state.

If the nucleus is excited it radiates gamma rays and all these rays are visible photographically by means of special emulsions.

It is because of the extreme short wave-lengths of x-rays and gamma rays that they are able to penetrate what are, on the face of it, solid substances such as flesh and bone and metal.

They can find their way between the parts of atoms and are so energetic that they can knock atoms apart.

All these rays of invisible light are now visible to us by means of cameras, electroscopes, cloud chambers and the like. Electronic devices have made many of these rays visible to the unaided eye by their effects on gases enclosed in chambers.

It has recently been discovered that infra-red rays have the power to penetrate the human skin and to a lesser extent the underlying tissues.

A photographic print of the skin made in this way is a weird looking thing. Because of the scattering effect on the skin and tissues these show up white on the print while any blood vessel shows up dark against the white of the skin and tissues. Many of the intricate details of the blood vessels are shown up. In fact such irregularities as varicose veins and blocked blood vessels and capillary congestion show up quite clearly and there appear to be great possibilities for this infra-red photography as an aid to medical diagnosis.

It is thus seen that the light which encircles the seemingly dark spaces of nature is a very potent force and as time goes on new and wonderful uses are being found for it. There is indeed no darkness in nature. It is the limitation of our sense of vision which provides for us an illusion of darkness.

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e Serviceman Who Tells

(Continued from Page 69)

ipment, but is even more valu- e for UHF work, where the size ore conventional units frequently ses them to act as very efficient uctors, remembering that at these quencies even a few inches of wire form a tuned circuit.

s a result, it is frequently very icult to provide efficient by- sing of screens, decoupling re- ors, &c., when using the usual er or mica types. A very much ner efficiency is shown by these miniature types, and they are quently the only solution to what be a very sticky problem.

may appear to have wandered ttle from the original theme, but eally want to establish these units their correct place in the scheme things. Efficient though they un- btedly are as bypasses at UHF, are not intended for use as pling condensers, their dielectric ulation being less efficient than a, and likely to give unreliable ults in such applications.

The whole point of the matter is t one application is more exacting n the other, and where a few gohms of leakage resistance is of le importance in a by-pass con- nser, it can play havoc in a upling position, as was clearly monstrated in the above case.

Just how the thing came to be ed I was unable to discover, for set had had more than one ner, but I could certainly see no stification for it. There was no k of room on the chassis, no high quencies were involved, and there s the disadvantage of the higher it cost. However, it was the only e of its kind in the set, which emed to indicate that it was the sult of a previous service job ther than part of the original sign.

The lesson to be learned is a simple e, I think: "Always use the right mponent in the right place."

A new deal in amplifiers

(Continued from Page 71)

the pickup head cleared from magnetic fields. A little can be tolerated in practice at full gain, but none at the volume setting at which the amplifier is operated. In nearly all cases, the gramophone motor and even the pickup arm, if metal and separated electrically from the coil, should be earthed through individual leads, having no connection direct to the equipment.

The amplifier is built on a chassis measuring 12 x 10 x 3 inches and the control unit on a panel 7 x 3½ inches. The cover for the control unit measures 6 x 3½ x 3 inches. None of these measurements is critical.

Voltages for the amplifier should work out at about 420 volts high tension, 260 volts for the 807 screens, and 22½ volts bias. Total current drain is about 130 mills. Actually, any voltage from 380 to 440 will be OK—the amplifier isn't sensitive on this point.

By using a .25 meg plate and .5 meg screen resistor for the 6AU6, input sensitivity will improve to about 75 mv and the feedback will rise to over 20 db. There is no objection, and a little to be gained by the change if your amplifier is still stable, as mine was. No other changes are required.

For 8 ohm speakers use a feedback resistor of 2000 ohms, and for 2.3 ohms, 1000 ohms.

In our next issue we hope to describe a more elaborate pre-amplifier, which adds facilities of bass and treble controls, and possibly a second amplifier circuit or a tuner. The entire series may take several months to complete.

The heat of the sun reaches us by radiation, travelling with the same velocity as light, or 186,000 miles per second.

HUNDREDS OF FANS

have already taken advantage of our unique, speedy service whereby we quote firm prices for all radio needs. By eliminating clerks, and using skilled technicians to price your lists, we make possible the lowest costs for the best—and most suitable—components you want. As you know, prices are about as erratic as the spark in a Geissler tube, but we at Collins Radio have evolved this simple plan for keeping them under some sort of control for you.

Here's what you do . . .

Simply send us a stamped, self-addressed envelope, together with a sheet of paper containing your name and address (PRINTED—clear enough for us to read). List on the left side, one under the other, the radio parts that interest you. The day we receive the list we'll fill in the latest prices and return it to you, holding the prices for 10 days. Then you select the parts you want and send us the sheet as your order, together with remittance for cost including postage or freight. Goods will be sent same day and any surplus will be credited to your account or refunded as you direct.

Simple, but efficient, so we invite you to try this speedy service. Remember if the parts you want are available we have them, or will get them for you.

COLLINS RADIO

409 Lonsdale Street, Melbourne C1., Victoria.

The Fastest Mail Order Service in Australia.

OPPORTUNITY

Send for details of a Special Postal Course in PLASTICS. Learn to make beautfiul plastic articles right on your own kitchen table. This is Your chance for a Business of your own. DON'T MISS IT. Write TO-DAY. Dept. B., Le Bon College (reg.), Box 279, Haymarket P.O., Sydney.

OFF THE RECORD — NEWS & REVIEWS

Is the ear the final judge in determining what is and what is not good reproduction? I wonder how many discussions have centred round this point. And yet I can't help feeling that many words have been wasted because those who argue these matters haven't made sure from the start that they were both talking about the same thing.

By JOHN MOYLE

ON page 60 of this issue there is a most interesting letter reprinted from the English *Wireless World* which underlines this. It makes a most vital point which is rarely appreciated. When we analyse the matter, it is obvious that we don't listen with our ears at all, but with our brain.

If, therefore, we wish to confine our discussions to a plane upon which judgment by our ears means whether something sounds acceptable or whether it does not, that is one thing. If we really mean to query whether the reproduction under discussion is so good that it wouldn't need to be any better, that is entirely another.

To illustrate what I mean, let us imagine we are listening to some good recordings played on an amplifier which is suffering from distortion in the upper register. To avoid buying an argument about distortion, let's assume it's something we can't argue about—horrible high-pitched fuzzes and buzzes due to a worn needle.

We would be quite safe, I think, in saying that our ears judge that reproduction as being poor. We wouldn't have pleasure in listening to it.

There are two remedies with two different results. The first wo be to turn down the tone con until enough of the high frequen were removed to remove also effects we didn't like. The mu now would be less brilliant—it mi even sound a trifle dull. Afte few minutes, however, we get use that, and our ears now tell us t the reproduction is pleasant.

That, I suggest, is the type treatment with which the aver listener is most familiar. He done it for years with his radio s He has been forced to accept a stricted range on recordings in m cases in order to keep the unwan surface noise within bounds. Li tations of equipment, too, have plied an automatic tone control "top cut" except in the very b circumstances.

LEARNED TO LOVE!

As a result, most people h learned to like this duller type sound. It's not so tiring because not so demanding.

Their ears have let them do badly because for years they h told the brain that a wider ra reproduction is always accompan with unpleasant effects, whereas tone control makes everything the garden lovely.

Harking back to our predicam with the originally distorted rep duction, let's imagine that we h just found the cause—a bad nee or stylus point. But instead of c ting down the tops with a tone c trol, we apply the second remedy that of fitting a new stylus. I mediately our distortion has go and we now have clean reprod tion with a much wider range.

If our ears now tell us that th results are also good, we must, think begin to be somewhat s picious of them as a means of asse ing what is good and what is bad don't mean that we should disca them as very useful things to det obvious distortion. But we m admit that they are somewhat eas going as indicators of absolute sta dards of fidelity.

CONVENIENT FACT

I wouldn't say, mind you, that should be upset about this. Aft all, it's convenient that we can a cept the results from a baby man set along with those from a radiogram and enjoy them both. I think we must look farther into t matter if we want to establish som thing deeper than the conventio assessment that a set is good or b just by listening to it. In fa without a much wider range of refe ence, we simply wouldn't be able say one way or another. We'd the same ears, of course, but t wider experience of listening h done something to alter the matt

Now a wider experience of an thing, whether it is listening or li

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goes right back to the impact ır senses and other faculties upon brain. If we take time off to yse them, our reactions to wide e or restricted range listening based primarily on our person- es, which are the summation of complete selves.

meone said that music is what are reminded of when we hear notes. It's true, too, that when ning to some well-known and d music, many of us won't even ry whether it's played on a tel set or on a radiogram—we'll ly the missing elements from own remembrance, and more still, from our own emotions.

other words, we must distinguish veen hearing the music and its sage, hearing merely the notes e music, and hearing a combina- of them both.

SIC A LANGUAGE

or music is merely a language which we become aware of what ehind the music. If the music things which have no place in elves, then it means nothing to If we have something in com- with the composer and the per- ner, it means a great deal. Be- en those two, our ears have a t time of it. But they can never more than the carriers of the ic—the real thing lies in the act of the music on our person- ies.

is is such an important thing in ning that it has a much greater ing on such things as volume frequency response that one ld imagine possible. Those who listened to good reproduction a wide range equipment will erstand this.

t first, the sheer delight in hear- clean bass, sharply etched cym- and brass, and full dynamic ge overshadows anything else. after a while, the inevitable ess of mental selection begins we find ourselves listening to erent sections of the music at erent times.

t one moment we are shocked keen awareness of a brass chord e next we might be luxuriating waves of well-scored strings, and se in turn might slide into our ntal background as a particularly ificant bit of wood-wind, possi- much less obtrusive in actual nd value, strikes through the rest n appeal possibly more emotional.

NTAL REACTIONS

t's very difficult to assess in a ning commentary the mental re- ions to music, but I think you l know what I mean. The first vement of the Beethoven Third nphony is one example I can nk of at random in which it is ost impossible to maintain a escent state of listening. Instru- nts and themes are continually usting to the forefront of our ening, a process which will vary er wide limits according to our od, circumstances, and the state of r experience of music and life.

I have ranged somewhat more dely over the point than I intended ginally, but maybe I should come ck to examining substitutes for the r as a judge of music.

On purely technical grounds, erefore, I think we can say that e more of the music we can hear th greater clarity, the better will the reproduction. This is some- ing we can only measure abso- tely with instruments more re- able than the ear. Our instruments never get used to deviations from wide range and other limits as do our ears. The latter can even get used to certain forms of distortion so that we may not at first like the impression of a cleaner outfit in which this distortion isn't present.

Now whether in the long run your personal preference is for any particular range or not is quite another matter. We will have to fall back on your own bank of experience and personality for that, whether your listening is an accompaniment to something else or a full time occupation and so on.

I only know that I've long ago given up trying to assess reproducers on a good or bad basis purely on listening tests, even though I have acquired a fairly wide experience with both good and bad. If I want to know why an outfit isn't doing so well, or to ascertain whether the top end is really doing its job, or merely fooling me, I fall back on instruments. I can get pleasure from hearing a good amplifier with moderate range, but I get more pleasure from one with full range. Often my ear won't tell me just where between these two my equipment actually lies. It's the instruments, not my ears, which tell me whether I'm getting the real thing or not, even though both sound good.

You may think I have arrived at the rather futile point. If I'm not aware of a lack of highs, shall we say it doesn't matter if they aren't there? But on that argument we'd still be driving old model cars because they aren't bad and we get used to them. That is until one day we sit in a new model and realise what we have been missing.

No, our ears are tricky things. They can tell us when something doesn't sound right, but they can't tell us how good it should sound or what to do about it if it's bad, except possibly the technician who recognises infallible evidence of technical troubles. But the layman often can't pick what is wrong—pickup, amplifier, room acoustics and so on.

It's a big subject, and often an individual one. But I would like something more consistent and accurate than my ears when assessing what is good or bad in reproduction.

Have I started another argument?

AUSTRALIAN ORCHESTRA RECORDS

The Civic Symphony Orchestra, conducted by Haydn Beck, is featured in an Australian-made microgroove record just announced. On one side is a recording of Eine Kleine Nachtmusik (Mozart) and on the other, five pieces for string orchestra by Grainger, Schubert, Haydn and Lotter.

The net profits from the record will go to the orchestra, which is having something of a struggle, despite its good standard of musicianship. This standard is well represented on this new Diaphon record, which sells retail for 45/- and is made by the Audio Photographic Record Co., 24 Moore St., Roseville, NSW.

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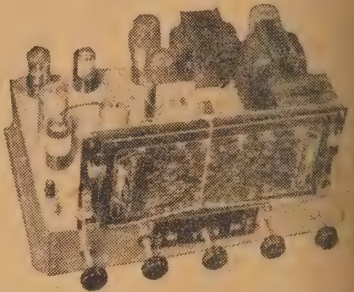

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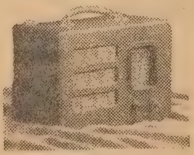

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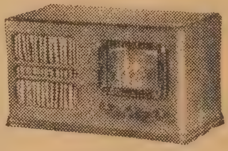

FIRESIDE 5.

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In addition to those already mentioned, many others are available such as:—

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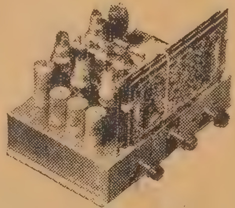
- A.C. Power Supply.
- 1947 Advance.
- Fidelity 5.

Etc. Etc. Etc. Etc.



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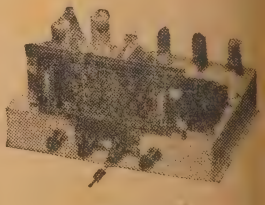

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MAGNETIC TAPE RECORDING

(Continued from Page 73)

eld across the gap should be
harply defined.

as shown last month in the dis-
n of AC biasing that each par-
showed remanent induction
rtional to the magnetising force
moment when it moved out of
ergising field. The prime re-
nent is therefore that the edge
field be sharply defined. This is
lled largely by the width of the
d by the precision of the work-
ces.

addition it is desirable to use
permeability materials for the
o minimise eddy current losses,
ularly at the higher frequencies.

TURNS

number of turns on the coils
il) must satisfy conflicting re-
ments. In the first place the
tance—and therefore the re-
ce—of the coil must be low in
arison with the source impe-
in order that the current
gh the coil shall be substantially
endent of frequency. If this
sion is not met the recording
nt reduces at the higher fre-
ies, leading to unnecessary
loss.

ntrarywise, the number of turns
t be reduced too far, otherwise
is a difficulty in achieving
ient magnetisation, which is
tially a function of ampere-

suming that the head is coupled
tly to a high-impedance plate
it of a low-power amplifier the
ere" quantity is definitely re-
ed.

ere for special reasons the head
nts an unusually low impedance
pling transformer must be em-
d and this represents additional
lication and expense.

e final requirement is that the
lings should show a reasonably
response to the bias frequency,
rwise an inordinate amount of
er is required from the bias (or
e) oscillator. The requirement
est fulfilled by keeping the
ral self-resonance of the wind-
higher, if possible, than the bias
uency.

some cases, a completely separ-
winding is provided on the head
the bias current.

mming these requirements, it is
l to make the total inductance of
head about 100 millihenries with
veen 1000 and 4000 turns of fine
in all on the coils.

YBACK HEAD

he reproducing head presents the
t difficult problem if good results
to be obtained.

s already mentioned, extreme
cautions have to be taken to pre-
t hum pick-up from nearby
tors and transformers. This in-
ves making the whole unit as
pact as possible and enclosing it
the most effective possible shield
partment. Liberties in shielding
nique can be taken with the erase
record head, but not with the
yback head.

ortunately the intensity of the
io field set up in the playback
d is quite small and the physical
size of the magnet structure can be reduced without much danger of pole-tip saturation. To the same end some designers prefer to use small low-impedance windings on the playback head, relying on a separate transformer to provide the necessary voltage step-up to the first amplifier grid.

Where it is elected to use a high impedance playback head the winding can contain as many turns as is physically convenient, provided that the self-resonance of the head and its associated circuit does not intrude into the expected audio range. It does not need to be referred in any way to the bias frequncy, which, in fact, is not recorded on the tape.

The second major requirement of the playback head is that the gap be as narrow and as clearly defined as is physically possible. It can be shown that the output will drop to zero at the frequency whose recorded wavelength on the tape corresponds to the gap length in the reproducing head. This is one of the factors which sets a prictical limit to the response of any given tape system.

In actual figures, the gap in the playback head should be reduced to at least 1-mil and preferably even smaller than that.

GAP DIMENSION

To achieve even the 1-mil figure the inner surfaces of the gap, constituted by the lamination edges, must be ground absolutely smooth and flat. If the edges are then clamped tightly on a scrap of aluminium foil, as for example from a tubular condenser, there is some hope that the gap will approximate the required dimension.

To achieve an even narrower gap, resort has been made in the commercial field to an electrolytic process which coats the pole faces with an isolating layer. Even with such measures it is difficult to achieve an effective and uniform gap width much les sthan .0005 inch.

In some cases the laminations have been simply butted together on the rather hit-or-miss assumption that dust and surface imperfections will retain some kind of an effective gap at the tips of the poles.

Much more could be said on the whole subject but additional information will be given in subsequent articles in the series.

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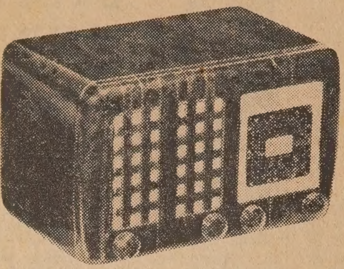

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NSWERS TO CORRESPONDENTS

'. **(Nyngan, NSW)** forwards his
ption and endorses a suggestion
by a reader on these pages in the
951, issue. He also asks whether
reless Institute of Australia (NSW
n) provides a correspondence
of training in the syllabus covered
classes held in Sydney, as men-
on page 93 of the above issue.

The subscription department has
d your subscription, R.S.Y., and
re now on the list commencing
ne August, 1951, issue, as requested.
regard to your suggestion con-
g the production of handbooks, the
emarks, regarding insufficient time
aper allocation, still apply. The
ss Institute of Australia (NSW
on) has for some time been enter-
g the idea of running a correspond-
ourse for country students in con-
on with the class held in Sydney,
ne difficulties of organisation and
se have proved quite an obstacle.
ver, there is a scheme under review
t the present time it is difficult
whether anything will come of it.

R. (Pukeatua, New Zealand) sends
his renewal of subscriptions and
to our notice an amendment to
ddress against the amateur call-
which has been allotted to him for
time.

Many thanks, G.L.R., for your subs.
al. It has been passed on to the
priate department for action. The
lment to your call-sign address has
noted for future reference. We
leased to note your success with the
Dip Oscillator which has been de-
d in the magazine. We agree that
a handy little device and have found
tremely useful on many occasions.
ks for your good wishes.

.G. (Banyo, Q) writes in apprecia-
of the Hobby Handbook and makes
suggestions for the next issue.

Many thanks for your remarks and
stions, R.L.G., and the latter will
ept in mind for our next issue.
exact date of this is a little obscure
e moment as there are qiute a few
ems to be overcome, not the least
hich is a paper allocation.

.W. (Campsie, NSW) wants to know
ere is any way in which he can
e the speed of his Garrard gramo-
e motor for use with LP records.
uggests either reducing the voltage
neans of a resistor or altering the
ng in the unit itself.

It is not likely that reducing the
ge will prove a satisfactory scheme,
e main factor controlling the speed
e governor, and the main require-
would be that this was capable of
g set to the slower speed. Even
e this can be done the results are
m satisfactory, it being practically
ssible to obtain constant speed. The
ation of the gear ratio is theoretic-
the sounder scheme, but we think
likely that this could be done with-
a major alteration to the structure
he motor. If this were done the
r would then only be suitable to the
er speed, and this is not likely to
e very convenient. All things con-
red, there seems no easy way out
he problem, short of buying a motor
gned for the job.

P. (South Yarra, V) wants to know
nere is a three-speed record changer
the market and also what is going
e the standard speed and whether 78
rds are going out.

: As far as we know the only three-
d record changer is that marketed
Stromberg-Carlson, and we believe
these will shortly be available to
home-builder. As to what the final
ction of record speeds will be—well,
e knew that one we would be some-
t unique, because we would be the
ones who did! However, it is ex-
nely unlikely that the 78 records will
discontinued for many years, if at
but it seems equally certain that
ne form of LP record will be avail-
for those items which justify it. In
regard it is quite likely that we
have more than one speed to choose
m, but at present no one knows ex-
y what the outcome will be.

.C.J.G. (Manly, NSW) wants to know
we can design a two-way loudspeaker system for use in elevator construction to provide communication between the elevator and control-room.

A.: We regret that we are unable to undertake the design of special circuits for individual readers as our time will not permit. We have on our files the circuits, &c., of an office inter-communication system suitable for any number of stations from two to 12. However, this is battery-operated and as it was designed for office use may not have sufficient power output for your requirements. It would be possible to modify this design to operate from AC and use higher-powered valves, but you may not feel competent to tackle this yourself. We know of no organisation who would undertake such design work, but there are several firms who specialise in supplying complete installations of this kind, and reference to the appropriate section of the telephone book will probably help in this regard. A complete set of circuits, &c., for the battery-operated device may be obtained by mail, price 1/6.

F.R.P. (Nambucca Heads, NSW) wishes to build a crystal set and wants to know if we can supply the details he will require and also whether it would operate satisfactorily at his location which is 40 miles from a transmitter.

A.: We have published a number of crystal set circuits over the past few years, the latest being in March and April of this year. Unfortunately, these copies are no longer available, but we can supply the circuits as well as those of previous designs through our postal service. At the same time it is unlikely that reception in your area will be very satisfactory from an entertainment point of view, and, in fact, you may have difficulty in getting any results at all.

YOUR QUERY?

1. Queries will be answered in rotation through the columns of our magazine if not accompanied by a fee for a postal reply.
2. Queries, neatly and concisely set out, will be answered by mail as quickly as possible if accompanied by 1/- in postal notes or postage stamps. Endorse envelope "Query."
3. Back numbers are rarely available but reprints of most circuits, wiring diagrams, and parts lists will be supplied for 6d each, minimum charge 1/-. Thus a circuit, layout, and parts list will cost 1/6 in stamps or a postal note. Endorse envelope "Circuit."
4. Blueprints of exact size chassis layouts with all essential holes, and cutouts will be supplied if available for 2/6. Endorse envelope "Blueprint."

Address your letters to the Technical Editor, "Radio & Hobbies," Box 2728C GPO, Sydney.

G.S.S. (Pemberton, WA) intends to build the battery charger described in Radio and Hobbies for November, 1950, but is a little doubtful as to the method of connection to the rectifier. He is also worried about the amount of heat generated and the effect on the one-ohm resistor.

A.: There is no objection to soldering the various leads to the rectifier, and the type specified has lugs provided for this purpose. The amount of heat dissipated by the resistor is important, as the temperature rise will be excessive if the resistor is too small and will most likely damage either itself or adjacent components. Providing the correct size is used, as specified, there will be no danger of melting the solder. Your form of construction should be satisfactory, but is as well to bear in mind that heat-generating components, such as the resistor, should be kept clear of the wood.

H.F.F. (Koolboo, Q.) writes to express his appreciation of the latest battery-operated dual wave set (Dual-wave Battery Five, June, 1951) and points out that a dual-wave set is an essential feature in locations such as his, due to the high atmospheric noise level on the broadcast band for about nine months of the year. His other main problem appears to be that of securing parts, as it apparently takes many months to get a complete kit together.

A. Many thanks for your letter, H.F.F., and we are glad to know that you are keen on this design as it was intended for just such conditions as you mention. You certainly seem to have more than usual difficulty in obtaining parts, and we would point out that there are a number of advertisers in our Radio & Hobbies who specialise in supplying complete kits of parts for our sets, and that they despatch these to all parts of the Commonwealth.

C.A. (Werribee, Vic.) wishes to build a Morse code oscillator and would like to see such a circuit using only one valve described in R & H.

A. Circuits of oscillators for beginners learning Morse code have been, from time to time, described in R & H. The latest one of the series was the Beginners Oscillator, which is battery operated and appeared in the August, 1949, issue. We regret that no copies of this issue are available, but circuits of this and other oscillators can be obtained through our query service.

A COURSE IN TELEVISION

(Continued from Page 59)

re-setting. In a multi-channel receiver, varying signal strengths from the different stations may upset the operation of the time base circuits unless an effective automatic gain control system is employed.

VERTICAL, HORIZONTAL HEIGHT: These two controls are normally mounted at the rear of the receiver and serve to limit the output of the respective deflection amplifiers. The correct adjustment of the two controls produces a picture which just fills the mask.

VERTICAL, HORIZONTAL CENTREING: The purpose and effect of these controls is obvious. Normally mounted on the rear of the set.

VERTICAL, HORIZONTAL LINEARITY: These appear only in the more elaborate types of receiver, their electrical position being indicated in the last article. They are accessible at the back of the receiver and require setting at rare intervals only or after tube replacements.

The ideal images for adjusting picture properties are those provided by test patterns which are normally radiated by stations between program periods. They normally contain items like the station call letters and occasionally a clock face showing the correct time.

The useful portion of the image, however, is a pattern of lines and tone graduations which are excellent for setting the receiver controls.

An analysis of test patterns and the faults indicated by improper reproduction can well form the subject of a separate article.

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Wanted to Buy, Sell or Exchange

FOR SALE: Eddystone 640. Condition as new. £60 or best offer. **K. Echberg, 14 Glyde St., Mosman Park, W.A.**

FOR SALE: American Triplett Pocket Voltohmmeter. £5 or offer. **14 St. Kinnord St., Essendon. FF8011.**

FOR SALE: 16mm British-Gaumont AC-DC Sound Projector. Complete with 5 feet glass-bead screen, 10 inch speaker, spare spools, splicer, ready to operate. If desired, I take complete Tape-recording outfit into exchange. **H. Tendys, 4 Loveday Street, Whyalla, Sth. Aust.**

FOR SALE: The "Retx" vented enclosure, price £7/10/-, scientifically designed, tested material, ½-hour assembly, early delivery direct from makers. Stamped envelope for enquires to **P. Horniman & H. Baxter, 9 Auburn Street, Goulburn, 2.S, N.S.W.**

SALE: Garrard 3-speed Automatic Record Changer. New. £31. **LU1060.**

SALE: 19 3S4, 6 IT4, 6 1S5, 9/- each. Brand new. Also 3 Polar 2-gang Condensers. £1 **Phone LB7134.**

SELL: BC 348 Q with 240 power, spkr., b'cast converter. £40 **Black, 6 Wilson St., Botany.**

SELL: Decca two-speed Motor Turntable Pickup has extra LP head. £23/10/-. **JA8647. 10 Lamette Street, Chatswood.**

SELL: R. & H. Full Sets, Vol. 4, 6, and 7. Two Sets, Vol. 8 & 9. Also 64 issues, from Vol. 1 to 12. **W. Brunton, 11 Luke Avenue, Burwood, N.S.W.**

SELL: Disc-Recorder. Many Presto features with 17" Turntable. Micro-groove and Standard lining. Syncro-tac Motor. Also 12" Recording-table and Motor. Must sell. Will consider offer. **A. E. Cohen, 30 Tovan-Akas Street, Bentleigh, Victoria.**

SELL: FHB Navy D/F Outfit, multi-tube 1-20 megs. Weight with power-pack and speaker, 3cwt, £75. BC342N 12 tube 1.5-18 meg. 110 volt, with transformer (no speaker), modified, £50. Phillips 3" Oscilloscope. Brand new, £25. Spare 9002 CR Tube, £2/10/-. Palec Resis.-Cap., Decade Box, as new, £7/10/-. TR1143 Transceiver, 100-124 meg., with tubes, £10. 3 1196 IFF's, new, £5 each. 5" Oscilloscope Kit, complete CR tube, all tubes, and components, £35. 4 spare 5BPI Tubes, £2 each. 2 P38 VHF Receivers, 13 tube, 100-150 megs., £20 each. 2 RAIOFA 7-tube Receivers, 150Kc.-10 megs., complete tubes, less switching meters, £15 each. 3 AR301 Receivers, with tubes, £8 each. C/R Tubes: 3 VCR139A, £2 each; 2 CR95, 15/- each; 6 CR85, 15/- each. 24 EF50 Valves, new, 15/- each. **F. Hicowe, Sorrento, Vic. Phone, Sorrento 150. Evenings after 7 pm.**

SELL: 1 ATR inverter 32VDC-220 AC. 100 W. Cont. 1 FS6 with power pack and leads. Valves. New 2 x 866 jr's; 2 x 6L6s, 3 x 807s, 1 x 6A6, 2 x 6SJ7s, 1 x 6J5 GT, 2 x 25 L6s, 1 x 6H6 GT. Transformers. "Red Line" Transformers. As New, 220-240 IN-650V. HT. One 220-240V IN-400V HT. One Fil. Trans. 200-240V-2.5VCT. 10A Output Transformers. Push pull, 10,000 ohm CT-15 ohms VC. Push pull, 8000 ohm CT 2.5 and 5 ohm VC. 2 power choke transformers 150 mils. 20 H. 1 1000V DCW. 2 mf; 1000V DCW 2 m.f. 1 Garrard type E pickup. New. 1 Goldring "Herdmaster" pickup, 3 heads transformer and tonaliser; 1 Goodmans 12" speaker; 2 Calston tran. con. 1/11 85 uuf; 2/15, 120 uuf, New. **Richard J. Moore, Elmshurst, Vic.**

SELL One ten-pin plug and socket, new; never been used, 15/-, posted. **B. S. Scott, c/o Railway Stn., Goomeic, Q.**

SELL: Garrard Changer Unit, Model 65A, complete, brand new, £21/10/-. **G. Benwell, 67 Draper St., Ormond, Victoria. Phone UL8520.**

SELL: Set of three vol. Modern Pract. Radio and Television. Dealing with design const. and maintenance of Radio, Telev. design and adjustments, £6/10/-. Book, Principles and Practice of Radio Servicing, £1/3/-. F.S.6 Vibrator power supply. Input 6v, output 175v and 290v What offer? **C. Anderson, Zeehan, Tas.**

SELL: Palec Valve & Circuit Tester, University Signal Tracer, A.R.C. Radio Engineering Course. All in good order Apply **W. Sleaford, William St., Rosewood, Queensland.**

WANTED: Marine Short-wave Receiver, 300 to 600 Kc. **P. F. Wall, 7 Dunlop Street, Parramatta.**

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WANTED To Buy: Different type Valve Sockets (Holders) from German ex-Army Radio Sets. **Albert Oaks, 192 Rossmoyne Street, Thornbury, Vic.**

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PAY 2/6, plus post, March, 1949 R. & H. **S. Smith, 6 George St., Enfield.**

EXCH. or Sell: Underwood 5 Typewriter, University all wave and audio oscillator, 6v Vib. power supply, 300v 150 mA, Gram. motor pickup, 5" Rola spkr. Want camera, plate preferred, 3½" x 2½" or ¼ pl. Send anywhere. **Thomas, 17A Pitt St., Redfern. WY3065.**

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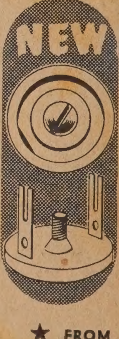

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